STATE OF MISSOURI

NONPOINT SOURCE
MANAGEMENT PLAN

March 15, 2000
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Missouri Department of Natural Resources
Water Pollution Control Program

FOREWORD

Missouri's Nonpoint Source Management Plan has been prepared by the Department of Natural Resources (DNR) and its many partners in response to the requirements of Section 319 of the federal Water Quality Act of 1987.

Nonpoint source (NPS) pollution results when water runs over land or through the ground, picks up natural or human-made pollutants, and deposits them in surface waters or groundwater.

The Water Quality Act of 1987 states:

> "It is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Act to be met through the control of both point and nonpoint sources of pollution."

This goal focuses on the importance of controlling nonpoint sources of water pollution. With the enactment of section 319 of the Water Quality Act, new direction and significant federal financial assistance for the implementation of state NPS programs were authorized. The Act required two major reports to be completed by August 4, 1988: a State Assessment Report describing the state's NPS pollution problems and a State Management Program explaining what the state planned to do during the subsequent four fiscal years to address their NPS pollution problems. The Act also authorized financial assistance for developing these reports and for implementing the state's Nonpoint Source Management Program.

State NPS management programs have matured considerably since passage of the WQA. All states have approved NPS management programs. As of late 1996, EPA had provided about $470 million in grants to states to implement these programs. Environmental progress is beginning to become apparent. However, technology, experience and new technical tools dictate the revision of state programs to build upon that past experience and move forward toward a new generation of management programs.

DNR and the citizens of Missouri who participated in development and review have prepared the Missouri Nonpoint Source Management Plan to further the protection of aquatic resources for current and future generations.

If you have questions or desire further information regarding NPS water pollution in Missouri, or its prevention, the Department of Natural Resources' staff will be pleased to assist you. Call the department's Environmental Assistance Office at 1-800-361-4827.

Stephen Mahfood, Director
Missouri Department of Natural Resources

ACKNOWLEDGMENTS

The hard work and many hours of agency staff members, organization members and private individuals who have contributed to this revision of the management plan and who have worked as partners in addressing NPS pollution in Missouri is greatly appreciated. This NPS pollution control and prevention program has been very active, well received and effective. It is a credit to those involved that they have cooperated in the face of many conflicts to make this program what it is.

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DIRECTORY OF ACRONYMS

ACP	Agricultural Conservation Program
ACRC	Agricultural Container Research Council
AFO	Animal Feeding Operation
AgNPS	Agricultural Nonpoint Source (project)
AML	Abandoned Mined Lands
AMP	Allotment Management Plan
BLM	Bureau of Land Management
BMP	Best Management Practice
BOD	Biological Oxygen Demand
C	Centigrade
Ca	Calcium
CAFO	Concentrated Animal Feeding Operation
CAP	Corrective Action Plan
CFR	Code of Federal Regulations
CFU	Colony Forming Units
COD	Chemical Oxygen Demand
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
Cu	Copper
CWA	Clean Water Act
CWC	Clean Water Commission
DDT	Dichloro-dephenyl trichloroethane
DEQ	Division of Environmental Quality
DGLS	Division of Geology and Land Survey
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DOH	Department of Health
DOT	Department of Transportation
DW	Drinking Water
EAM	Even-aged Management
EAP	Environmental Assurance Program
ECARP	Environmental Conservation Acreage Reserve Program
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
ESP	Environmental Services Program
FAIR	Federal Agriculture Improvement and Reform (Act)
FAPRI	Food and Agriculture Policy Research Institute
FHWA	Federal Highway Administration
FIP	Forestry Incentive Program
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FS	Forest Service
FSA	Food Security Act
FSA (USDA)	Farm Service Agency
FTE	Full-time Equivalent
GIP	Grazing Incentive Program
GIS	Geographic Information System
GPD	Gallons per Day
HDPE	High Density Polyethylene
HWP	Hazardous Waste Program
I&E	Information and Education
IPM	Integrated Pest Management
K	Potassium
LOA	Letter of Approval
LRP	Land Reclamation Program
MASBDA	Missouri Agricultural and Small Business Development Authority
MCL	Maximum Contaminant Level
MDA	Missouri Department of Agriculture
MDC	Missouri Department of Conservation
MDOH	Missouri Department of Health
Mg	Magnesium
MLRA	Missouri Land Resource Assessment
MoWIN	Missouri Watershed Information Network
MSA	Missouri Soybean Association
MSEA	Management Systems Evaluation and Analysis
MTBE	Methyl-tetra-butyl-ether
N	Nitrogen
NAWQA	National Water Quality Assessment

NEPA	National Environmental Policy Act
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NPSMP	Nonpoint Source Management Plan
NRCS	Natural Resources Conservation Service
NRI	National Resource Inventory
NURP	Nationwide Urban Runoff Program
OA	Office of Administration
ORD	Office of Research and Development
OST	Office of Science and Technology
OWOW	Office of Wetlands, Oceans and Watersheds
P	Phosphorus
PAH	Polynuclear Aromatic Hydrocarbon
PAN	Plant Available Nitrogen
PAT	Pesticide Applicator Training
Pb	Lead
PCB	Polychlorinated biphenyl
PCP	Pentachlorophenol
PDWS	Public Drinking Water Supply
POTW	Publicly Operated Treatment Works
PPM	Parts per Million
PFRP	Process to Further Reduce Pathogens
PSRP	Process to Significantly Reduce Pathogens
QA/QC	Quality Assurance/Quality Control
RAFTMP	Regional Ambient Fish Tissue Monitoring Program
RBCA	Risk-based Corrective Action
RC&D	Resource Conservation and Development
RCRA	Resource Conservation and Recovery Act
REMAP	Regional Environmental Monitoring and Assessment Program
RSMo	Revised Statutes of Missouri
SALT	Special Area Land Treatment
SB	Senate Bill
SDWA	Safe Drinking Water Act
SIC	Standard Industrial Classification
SIP	Stewardship Incentive Program
SPMD	Semi-permeable Membrane Device
SOC	Synthetic Organic Contaminant
SOUR	Specific Oxygen Uptake Rate
SRF	State Revolving Fund
STORET	Storage and Retrieval
SWCD	Soil and Water Conservation District
S&WCP	Soil and Water Conservation Program
SWMORC&D	Southwest Missouri Resource Conservation and Development
SWMP	Solid Waste Management Program
T	Tolerable
TAP	Technical Assistance Program
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TRMP	Total Resource Management Plan
TP	Total Phosphorus
TSS	Total Suspended Solids
USDA	US Department of Agriculture
UAM	Uneven-aged Management
USGS	US Geological Survey
UIC	Underground Injection Control
UST	Underground Storage Tank
WHIP	Wildlife Habitat Incentive Program
WQ	Water Quality
WQA	Water Quality Act of 1987
WQL	Water Quality Limited
WRP (USDA)	Wetland Reserve Program
WRP (DNR)	Water Resources Program
Zn	Zinc

EXECUTIVE SUMMARY

Missouri's Nonpoint Source Management Plan (NPSMP) has been prepared by the Department of Natural Resources (DNR) with the assistance of partner agencies and Missouri citizens in response to the requirements of Section 319 of the federal Water Quality Act of 1987 (WQA). The first plan was approved by EPA in 1989 and remained in place until preparation of the current edition.

Nonpoint source pollution results when water runs over land or through the ground, picks up natural and human-made pollutants, and deposits them into rivers, lakes, and coastal waters or groundwater. Where it is contributing to a water quality problem or potential problem, measures are taken to reduce nonpoint source (NPS) water pollution. The measures taken depend on the extent and causes of the problem. Missouri's expectations for water quality are defined in the state's water quality standards. In general, the desired level of water quality depends on how the water will be used. For example, water to be used for irrigation need not be of the same quality as water for swimming or drinking. The standards also establish an expectation that waters in Missouri will not be degraded and that all waters will meet certain criteria, such as being free from debris. Waters that fail to meet any of the water quality standards are called impaired.

In order to prevent or control NPS pollution, the pollutants or conditions must be identified, their role in water quality must be understood and the sources of the pollutants or conditions must be identified. For a preventive practice to be effective, it must be able to interfere with the availability, detachment or transport of a pollutant or the creation of a condition that causes the impairment.

Nine Key Elements of an Effective State Program

In 1996, a committee of state and EPA representatives, called the National Nonpoint Source Working group, developed a list of the elements considered essential in an effective state NPS management program. The workgroup was sponsored by the Association of State and Interstate Water Pollution Control Agencies and included a participant from Missouri. The guidance developed by this workgroup contains the framework by which state programs must be revised and by which management plans will be evaluated by EPA. The elements include:

1. explicit short- and long-term goals, objectives and strategies;
2. strong working partnerships and linkages to federal, state, regional, local and private entities;
3. an approach balancing statewide and local on-the-ground programs;
4. NPS abatement and prevention of future degradation;
5. identification and prioritization of impaired waters with a plan and schedule to address those waters;
6. minimum contents of a management plan as defined in section 319(b) of the CWA;
7. federal consistency review;
8. efficient and effective program and financial management;
9. management plan review and update at least every five years.

Missouri's Nonpoint Source Management Plan (NPSMP)
The Missouri NPSMP is by definition a plan for the state. It is written with the help and input of partners from other agencies, private organizations and citizens who share in the responsibility and concern for managing nonpoint sources of water pollution. Working together, the various partners developed goals, objectives, strategies and evaluation methods for achieving improved water quality as it relates to NPS pollution. These goals, objectives and strategies are supported by the strategic plans of many partner agencies including the Missouri Departments of Natural Resources, Health, Conservation, and Agriculture; University Extension; and Natural Resources Conservation Service.

The stated mission and goals of the NPSMP are as follows:

Mission

Preserve and protect the quality of the water resources of the state from NPS impairments.

Goal A: Water Quality Assessment, Monitoring and Prioritization
Continue and enhance statewide water quality assessment processes to evaluate water quality and prioritize watersheds affected by NPS pollution.

Goal B: Water Quality Improvement and Protection
Improve water quality by implementing NPS-related projects and other activities.

Goal C: State Nonpoint Source Program Management
Maintain a viable, relevant, and effective Nonpoint Source Management Program with the flexibility necessary to meet changing environmental conditions and regulations.

Specific, quantifiable objectives have been developed to help achieve these goals, accompanied by methods to be used in evaluating success in meeting the goals and objectives.

Nonpoint Source Management Prioritization
Beginning with their 1987 guidance to states for preparation of the 1988 state water quality assessments, EPA has outlined NPS pollution categories and subcategories each state must address. As required, Missouri's NPSMP designates the categories and waterbodies of highest priority in the state. The individual category narratives (Appendix E) characterize the impact of that category, denote any regulatory authorities existing and suggest recommended changes, if needed.

Missouri's priority nonpoint sources are:
1. Agricultural Nonpoint Sources
The agriculture industry is one of the state's largest industries. Land in farms makes up 28.5 million acres or 65 percent of the state with about 16 million acres of that either harvested or pastured land (Bureau of the Census, 1994). Given the relative scale of the activity, the potential for NPS pollution places agricultural operations at the top of the priority ranking, as determined by category of pollutant. Within that category, sediment, fertilizer, pesticides and animal waste are the primary pollutants.

2. Urban Nonpoint Sources
Urban nonpoint sources are a major concern as urban areas continue to expand at increasing rates. Urban nonpoint sources have had a significant negative influence on water quality.

Sediment is the primary contaminant, and severe water quality impacts also stem from the modification of storm flow regimes and the loss of aquatic habitat.

3. Acid Mine Drainage from Abandoned Coal Mined Lands

These sites are primarily historical in origin. The presently operating mines are regulated to the point that contaminants are controlled through permits. Abandoned mined lands contribute localized chronic impairments and episodic impacts to Missouri's water bodies. The primary contaminants are acidity and sulfate. The scale of many sites is too large to be addressed through NPS funding, although smaller treatable sites may be considered. Other sources would be required to address the universe of these problem areas.

In addition to priority categories, the state is required to identify priority waters. In Missouri, priority waters are:

- those on the 303(d) list,
- those designated as Outstanding National or State Resource Waters,
- waters that are not yet degraded enough to be on the 303(d) list but are in need of protection to prevent their listing.

Funding priorities will follow the above prioritization but will pursue a broader program where possible in order to provide a balanced approach to NPS pollution prevention.

Missouri has historically used a watershed ranking to prioritize watershed projects. Pursuant to the Clean Water Action Plan, each state was required to develop a Unified Watershed Assessment (UWA) based on an 8-digit hydrological classification unit. Of Missouri's 66 8-digit hydrological units (HU), 56 are identified as Category I watersheds. These 56 were evaluated and prioritized. Five watersheds were identified as priorities for restoration work in 1999 and an additional five were identified for 2000, for a total of 10 watersheds.

The use of the 8-digit HU poses significant challenges when trying to use the UWA as a prioritization tool for NPS activities. For this reason, Missouri has chosen to use the 303(d) listing as the primary prioritization tool and will use the UWA as a secondary tool as appropriate. It is expected that the UWA will be refined in the future at which time it may more appropriately be used in this prioritization process.

Missouri has two special focus areas for NPS activities: development of voluntary water quality management plans and/or TMDL implementation strategies, and implementation of watershed restoration projects. To achieve protection and restoration, Missouri's NPSMP supports implementation of voluntary water quality management plans (WQMP) and/or TMDLs. A framework or template for assembling a voluntary WQMP that can be approved as part of the TMDL process is included in the plan. The voluntary WQMP/TMDL strategy will inform citizens of their watershed status, provide for public participation, marshal any available incentives for voluntary action and help provide the tools to allow locally led groups to be effective.

The federal Clean Water Action Plan directed states to focus substantial effort on the restoration of impaired waters. Funding pursuant to this plan is required to be used for restoration projects. Missouri will consider this requirement in prioritizing NPS activities.

Nonpoint Source Assessment

The assessment program for NPS pollution includes many aspects and includes the efforts of many agencies, groups and individuals. The major monitoring activities include:

Fixed Station Monitoring Network – Thirty of the 40 stations in Missouri's fixed station chemical monitoring network are sites uninfluenced by point source discharges making them good indicators of regional nonpoint sources. The sites cover all major physiographic regions of the state and provide information on storm water runoff and subsurface flow during base flow conditions. The network includes six large springs. Including data generated by other agencies, about 70 sites are used to collect NPS pollution data. Additionally, over 100 drinking water reservoirs are sampled quarterly.

Fixed Station Fish Tissue Network – With the passing of the use of chlorinated hydrocarbon insecticides there is less need for aggressive fish tissue monitoring. DNR and EPA jointly maintain a monitoring network of fifteen stations with half of the sites sampled. The Missouri Department of Conservation (MDC) also collects and analyzes many fish tissue samples per year. Fish tissue monitoring in Missouri has documented declines in chlorinated hydrocarbon insecticides in fish over time, but increasing levels of mercury.

Special Studies – Many projects fall into this category including monitoring of 319 and other watershed projects, US Geological survey monitoring and NAWQA studies and the USDA Management Systems Evaluation and Analysis (MSEA) Project.

Aquatic Biological Community Data – Over the years a large volume of data has been gathered, a primary source being William Pflieger's *Fishes of Missouri* which summarized fish distribution in the state from records from 1853 through 1969. DNR routinely monitors 45 sites for biological conditions and other agencies conduct similar activities. Considerable unpublished data is available from MDC, EPA and DNR studies.

Volunteer Water Quality Monitoring Program – Citizen monitoring groups have submitted over 2000 sets of physical, chemical and /or biological data for monitoring sites throughout the state. Volunteer data is used as supplemental information by state and local decision-makers to determine current stream conditions and to identify potential problems or trends in water quality. Volunteers send data for over 200 stream sites.

Missouri also has a strategy for NPS assessment. This assessment involves several issues. Discrete, localized nonpoint sources such as drainage from abandoned mine lands can be accurately characterized by water chemistry studies. Frequency and concentrations of synthetic organic chemicals, such as pesticides, have been well documented by chemical monitoring. Large scale, diffuse sources are much more difficult to quantify. Missouri has relied heavily on fish distribution that has shown the loss or decline in fish populations of certain species. This data, combined with studies in the technical literature on the impacts of channelization and other physical disturbances has been the foundation of the assessment that agricultural NPS pollution

affects virtually all streams in the glaciated plains, Osage plains and bootheel regions of Missouri.

Areas of interest that may increase the understanding of stream processes and NPS pollution are: research into relationships of nutrients, algae and suspended sediments; research on stream biota and how they are affected by physical changes in stream channel and riparian zone; and development of biological criteria for aquatic macroinvertebrate communities and subsequent development of a statewide fixed station network of aquatic macroinvertebrate monitoring sites.

Funding

Sources of funding for NPS management are provided at federal and state levels. Examples include CWA 319, 104(b), FIFRA, SDWA, State Revolving Loan Fund, etc. This section describes the different sources available and how they may be used for NPS management in Missouri.

The Water Quality Act requires the state to maintain its funding for NPS management at or above the average of its NPS management funding for FY 1986 and FY 1987. There were no state funded NPS activities during that period; therefore, Missouri's "Maintenance of Effort" level is zero dollars.

Milestones

To evaluate progress in achieving the goals of the NPS management program, milestones have been developed indicating lead agencies and the timeframes for achieving certain actions.

Appendices

Some of the items required to be included in the NPS management program have been included in this document as appendices. Other appendices provide supporting or background information. As such, the appendices are an integral and important component of the NPSMP.

The appendices include a copy of EPA's Nine Key Elements of an Effective State Program; information on the methods used to develop and review the planning document; legal certification for the NPS program; a discussion concerning federal consistency review; descriptions of the pollutant categories, best management practices and regulatory authorities; the 303(d) list and other lists of water bodies relating to water quality; a description of watershed implementation activities currently underway in Missouri; a description of entities providing implementation assistance; a proposed water quality monitoring program; and a discussion of section 319 as it relates to the Clean Lakes Program.

I.

INTRODUCTION

INTRODUCTION

What is nonpoint source (NPS) pollution and why does it need to be assessed or managed?

"Nonpoint source pollution occurs when rainfall, snowmelt, or irrigation runs over land or through the ground, picks up pollutants, and deposits them into rivers, lakes, and coastal waters or introduces them into ground water." (U.S. Environmental Protection Agency)

In other words, it is pollution that enters waterways by overland flow or infiltration as opposed to through conveyances such as pipes or channels.

By the early 1970s many streams and lakes across the land had become open conduits for the nations' sewage and industrial wastes. With passage of the Federal Water Pollution Control Act of 1972 (PL92-500), Congress set in motion a massive cleanup effort. Throughout the following decades hundreds of waste treatment facilities were constructed. Previously polluted streams and lakes became cleaner and aquatic life began to reappear where it had been absent.

However, 24 years and billions of dollars later, we have not yet completely achieved the goals of water that is clean enough for swimming, recreational uses and protection of aquatic life. Only about half of today's pollutants come from pipes, often referred to as point sources. The remainder of pollution comes from nonpoint sources.

Before measures can be taken to reduce NPS pollution, a determination must be made that a water quality problem exists along with its extent and its cause. In order to do that, we must first define water quality. The following paragraphs are from the *Water Quality Field Guide* published by USDA-Natural Resources Conservation Service:

> "The first step when addressing water quality is to determine if there is a problem, and if so, its nature and magnitude. A problem occurs when there is an unfavorable condition in the receiving waters, which adversely affects a designated use of water. Some of the more common uses are for irrigation, livestock, recreation, fish and wildlife, and for domestic use. If any of these [designated] uses are impaired, there is a water quality problem.
>
> "Water quality is not easy to define. The desired level of water quality depends upon how the water will be used. Water for irrigation need not have the same [level of protection] as water for swimming or drinking. Even irrigation water quality may vary, depending on the salt tolerance of the crops to be irrigated. If, for example, irrigation water is so saline as to restrict plant growth, its use is impaired and we say the water quality is poor. It is in the context of use impairment that the term "water quality" should be used.

“A water quality problem may be highly localized (fish kill in a farm pond) or regional, national or even international in scope. The water quality problems in Lake Erie, for instance, involve the U.S. and Canada and include recreation, drinking water, and commercial fishing uses, among others. Problem identification may be as simple as a complaint to a local health board or as structured as the national planning process that took place under Section 208 of the Water Quality Act. Many of the water quality management plans developed in this process identify water quality problems and prioritize them for action.

“The following principles are important in developing a step-by-step procedure for nonpoint (diffuse) source pollution control:

1. ***For a water quality problem to exist, the water must be impaired for some [designated] use*** - drinking water supply, fishing, recreation, etc. The same body of water may have one or more totally different problems depending on its various uses. The physical, chemical, and biological characteristics of the water body [and their interrelationships] will determine the severity of the water quality problem and the potential for improvement with implementation of control measures. Naturally occurring substances, such as phosphate and nitrate, are pollutants only when their concentrations in the water are high enough to cause a water quality problem.

2. ***Once the pollutant or pollutants*** causing the water quality problem ***are identified, the roles of the pollutants*** in deteriorating water quality ***must be understood and the sources*** of the pollutants ***must be identified.***

3. ***The process by which each nonpoint source pollutant is generated and transported to the water body must be identified.*** The ***availability*** of a pollutant to be lost from the land, and its ***detachment*** and ***transport*** will depend on the physical, chemical, and biological properties of the pollutant and its reactions in soil and water. Pollutants that are strongly adsorbed by soil are susceptible to detachment and transport with the soil. Soluble materials that have a low affinity for soil particles are more susceptible to leaching losses.

4. ***For a practice to be effective in reducing diffuse sources of pollutants, it must be able to interfere with the availability, detachment, or transport of a pollutant.*** In other words, the practice must decrease the availability, prevent the detachment, or interrupt the transport process if the pollutant load is to be decreased. In selecting an appropriate practice, one must consider the relative merits of permanent practices that have high capital costs versus those that have lower capital costs but require careful continuous management by the [land manager]. Practices that solve one water quality problem must not increase the potential for another problem. Practices may be appropriate for certain types of

problems (e.g., no till for reducing soil erosion), but if that practice does not adequately control the target pollutant, then it cannot be considered the ‘best management practice’ for solving the existing water quality problem.” (NRCS)

This document, the Missouri Nonpoint Source Management Plan, addresses how Missouri intends to improve and protect water quality impacted or threatened by NPS pollution.

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U.S. Department of Agriculture, Soil Conservation Service. Water Quality Field Guide, 1983. Revised 1988.

U.S. Environmental Protection Agency, Office of Water. Nonpoint Source Guidance, 1987.

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II.

NINE KEY ELEMENTS OF AN EFFECTIVE STATE PROGRAM

Missouri's Approach

NINE KEY ELEMENTS OF AN EFFECTIVE STATE PROGRAM
Missouri's Approach

In 1996, a committee of state and EPA representatives, called the National Nonpoint Source Working Group, developed a list of items considered to be the essential components of a state NPS management program. The committee was sponsored by the Association of State and Interstate Water Pollution Control Agencies. These components were embodied in guidance commonly referred to as Nine Key Elements of an Effective State Program (Appendix A). This guidance will be used by EPA to evaluate each state's NPS management program. States that successfully incorporate the nine key elements into their programs and have a proven track record of effective implementation will be recognized Nonpoint Source Enhanced Benefits States and be provided maximum flexibility in implementing their programs and other benefits. Management plan approval by EPA is required for states to continue to receive any Congressional appropriations over the national formula, approximately $2.3 million for Missouri.

To summarize how Missouri has incorporated these elements into its program, each key element is listed below in bold type and is then followed by explanatory text that elaborates on how Missouri is fulfilling or will fulfill the requirement(s) for that element.

1. **The state program contains explicit short- and long-term goals, objectives and strategies to protect surface and groundwater.**

Missouri's long-term goals include enhanced monitoring and assessment, improved surface and groundwater quality, and the continuation of a viable, effective, and flexible NPS management program. Each of these goals has short-term objectives, implementation strategies, evaluation measures, and milestones to gauge success and progress. The first goal, which addresses monitoring and assessment, is focused on improving the tools needed to adequately assess the quality of watersheds so priorities for restoration may be established. Water quality improvements are the subject of the second goal, which aims to achieve and maintain beneficial uses of water. Missouri's third major goal is to maintain a viable, effective, and flexible NPS program by adhering to federal guidelines, involving NPS partners and the public in the management process and following an adaptive management approach.

2. **The state strengthens its working partnerships and linkages to appropriate state, interstate, tribal, regional and local entities (including conservation districts), private sector groups, citizen groups and federal agencies.**

Missouri's Nonpoint Source Management Program is a product of the coordination that occurs among many partners within the state. One way this process is facilitated is through the Water Quality Coordinating Committee (WQCC) which meets monthly to present and discuss information on water quality issues in the state. The WQCC is comprised of representatives from federal, state, and local agencies, private sector groups and citizen groups. This committee

and the general public were instrumental in both an interagency review and public review of the draft NPSMP, the drafting of Missouri's Unified Watershed Assessment and development of the 303(d) list of impaired waters. Partner input will continue to be important for the successful implementation of NPS management efforts in the state of Missouri. Many of these partners are listed in Appendix B.

The goals of many of the partnering agencies directly correlate to many of the Nonpoint Source Management Program goals, objectives and strategies. For example, the Missouri Department of Health has objectives related to on-site sewage systems that directly relates to the plan's stated goals for improving water quality and preventing groundwater contamination. Section II of this document includes excerpts from strategic plans of many of the nonpoint source partners and identifies how those relate to the goals, objectives and strategies of the Nonpoint Source Management Program.

The Nonpoint Source Management Plan was developed in partnership with a variety of organizations, local government representatives, commodity groups, agencies and others. A workgroup was convened to finalize the plan, focusing particularly on the goals and objectives. This process is described in Appendix B, along with a list of review participants.

Other mechanisms that are used to form and sustain partnerships are Memoranda of Agreement, letters of support, cooperative projects and combining of funds. Nonpoint source projects are watershed-based and incorporate various organizations and interests into all stages of development and implementation. A new requirement for projects funded under Section 319 is the development of a Watershed Restoration Action Strategy (WRAS) which will further efforts to form and sustain partnerships within watersheds. Appendix I contains information on various watershed implementation projects in Missouri, including information about partners involved in the projects. Appendix J identifies the partners assisting in implementation of Missouri's NPSMP.

3. The state uses a balanced approach that emphasizes both statewide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened.

Missouri's approach emphasizes support of community-based, locally led, watershed-defined water quality projects. Appendix I details existing watershed implementation projects. Goal B includes several objectives encouraging the development of locally led watershed projects.

In addition, Missouri emphasizes statewide activities including development of the 303(d) list, maintaining and evaluating water quality assessment data statewide, development of a Unified Watershed Assessment, and maintains a state NPS unit within DNR.

4. The state program (a) abates known water quality impairments from nonpoint source pollution and (b) prevents significant threats to water quality from present and future nonpoint source activities.

Section IV of the plan details the priorities for NPS activities in Missouri. Waters are prioritized as follows (in order):

1. Waters on the 303(d) List
2. Prevention of Degradation of High Quality Waters
3. Waters Almost Meeting Criteria for Inclusion on the 303(d) List

Additional focus is placed on priority watersheds identified in the UWA, locally led watershed projects involving voluntary TMDL implementation strategies and locally led, good quality watershed projects.

5. The state program identifies waters and their watersheds impaired by nonpoint source pollution and identifies important unimpaired waters that are threatened or otherwise at risk. Further, the state establishes a process to progressively address these identified waters by conducting more detailed watershed assessments and developing watershed implementation plans, and then by implementing the plans.

Missouri has an approved 303(d) list of impaired waters and an approved Unified Watershed Assessment (UWA). The 303(d) list is included as Appendix F and the UWA can be found on the Internet at {http://www.cares.missouri.edu/mowiap/}. Section V of the plan details the state's water quality monitoring activities and strategies for NPS assessment. Appendix K contains a proposed water quality monitoring program for Missouri. Goal A of this document also addresses monitoring and assessment.

6. The state reviews, upgrades and implements all program components required by section 319(b) of the Clean Water Act, and establishes flexible, targeted and iterative approaches to achieve and maintain beneficial uses of water as expeditiously as practicable. The state programs include:

- **A mix of water quality-based and/or technology-based programs designed to achieve and maintain beneficial uses of water; and**

- **A mix of regulatory, non-regulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.**

Appendix E includes a discussion of the NPS categories, including a discussion of best management practices for each of these categories. Additionally, Appendix H addresses best management practices for lakes. Missouri's watershed implementation activities are detailed in Appendix I and reflect the use of both technology-based and water-quality based activities. The goals and objectives in this plan further reflect this balance.

Missouri's approach is one of voluntary pollutant prevention and control in implementing NPS projects, believing that the best solutions to water quality problems are those with broad and active local support and involvement. Citizens across Missouri are proceeding with watershed enhancement projects. However, in those areas with listed waters where an effective local commitment to water quality improvement is slow to form, DNR and other agencies will move ahead with the actions necessary to implement the law and protect water quality.

DNR has developed a strategy for Total Maximum Daily Loads (TMDLs) which contains a schedule for establishing TMDLs on impaired waters.

7. The state identifies federal lands and activities which are not managed consistently with state nonpoint source program objectives. Where appropriate, the state seeks EPA assistance to help resolve issues.

Federal consistency review is addressed in Appendix D. Several tools exist for evaluating federal consistency. DNR will work with OA and through the NEPA process to assure early notification and effective communication to accomplish the consistency review process and achieve its clean water goals, and further DNR will work with the federal agencies which administer federal permit and licensing programs. Development of Watershed Restoration Action Strategies will also provide an opportunity for addressing consistency on federal lands.

8. The state manages and implements its nonpoint source program efficiently and effectively, including necessary financial management.

Missouri makes extensive use of the Grants Reporting and Tracking System, administered by EPA, for quarterly reporting activities. DNR has an effective project oversight procedure, requiring thorough documentation and reporting on projects to ensure appropriate expenditures of funds.

9. The state periodically reviews and evaluates its nonpoint source management program using environmental and functional measures of success and revises its nonpoint source assessment and its management program at least every five years.

Missouri's NPSMP will be evaluated and updated every five years using an adaptive management framework. Environmental measures of success include assessing the trend in the number of impaired lakes acres and stream miles listed on the 303(d) list and the number of sources of groundwater contamination, all related to NPS pollution. Functional measures include, but are not limited to, an EPA approved management plan and milestone progress. Goal C includes objectives related to revisions of the plan, including a schedule.

III.

MISSOURI'S NONPOINT SOURCE MANAGEMENT PLAN

NPSMP GOALS AND OBJECTIVES

EXCERPTED STRATEGIC PLANS OF NPS PARTNER AGENCIES

NONPOINT SOURCE MANAGEMENT PLAN
(NPSMP)

The Missouri Nonpoint Source Management Plan is, by definition, a plan for the state. As such, it requires the cooperation and coordination of all partners addressing NPS issues in order for it to be successful. The Missouri Department of Natural Resources (DNR) is the designated state water quality agency and, therefore, is responsible for taking the lead on the NPSMP. This plan, however, is written with the help and input from all the partners who share in the responsibility for managing nonpoint sources (Appendix B). As a state plan, it contains some elements beyond the purview and legal authority of the DNR (Appendix C) but other partners address those elements. This section of the NPSMP is structured to help readers understand where the partners overlap and differ in their strategic plans but as a whole achieve the goal of the NPSMP. Following the goals, objectives, and strategies of the NPSMP, excerpts from the strategic plans of the partners have been provided with reference made to where they meet or enhance specific objectives or strategies of the NPSMP *(NPSMP Objectives/Strategies X.x.x)*. The excerpts have been typed verbatim. If you have questions or comments regarding any of the strategic plan excerpts, please contact the agency responsible for that plan.

NPSMP GOALS, OBJECTIVES AND STRATEGIES

The NPSMP is a five-year plan. The broad goals described below are intended to identify the general activities necessary to achieve the stated mission. The objectives reflect the five-year life of the plan, with most of them being targeted for completion in five years or less. At that time, the mission, goals and objectives will be reevaluated to determine if the objectives were achieved, if the objectives were appropriate for reaching the goals and if the goals are appropriate for achieving the mission.

Mission *Preserve and protect the quality of the water resources of the state from nonpoint source impairments.*

Goal A: Water Quality Assessment, Monitoring and Prioritization

For at least the next five years, continue and enhance statewide water quality assessment processes to evaluate water quality and prioritize watersheds affected by NPS pollution.

Goal A: Objectives

1. Periodically assess and prioritize watersheds in need of restoration due to NPS pollution based on available methodologies.
2. Continue to improve water quality monitoring methods used to assess NPS pollution.
3. By 2001, develop and propose to the Clean Water Commission numeric biological criteria, as a water quality standard, to better identify those impacted wadable streams incapable of supporting the expected biological community.
4. Publish a report of water quality assessment efforts using improved methodologies by 2005.
5. Coordinate with USEPA to develop nutrient criteria and propose those criteria as water quality standards by 2003.

Goal A: Implementation Strategies

a. Coordinate with NPS partners to develop biocriteria and nutrient criteria.
b. Continue statewide monitoring of aquatic fauna and flora.
c. Conduct special studies of habitat and fish communities.
d. Conduct fish tissue sampling.
e. Collect, manage and disseminate quality-assured water quality data.
f. Support training of volunteers.
g. Continue monitoring on the Missouri and Mississippi Rivers.
h. Review available data and watershed priorities.
i. Review existing water quality standards every 3 years.
j. Develop a watershed prioritization tool useful at the 14 digit HUC level of detail.
k. Continue to develop aquatic macroinvertebrate biocriteria.
l. Maintain the level of effort and cooperation achieved for water quality monitoring and water quality data management at or above FY 2000 levels.
m. Participate in USEPA Region 7 nutrient criteria workgroup.
n. By 2004, complete at least 20 TMDL studies.
o. Facilitate the development and use of watershed water quality modeling of NPS pollutants such as contaminated sediments, suspended sediment, pesticides and nutrients.
p. Integrate karst protection strategies to monitor nonpoint source contributions to water degradation.

Goal A: Evaluation Measures

a. Production of 303(d) list, 305(b) report and updated Unified Watershed Assessment.
b. Establishment of biological and nutrient criteria as water quality standards.
c. Number of TMDL studies completed.
d. Number of watersheds with ambient monitoring.
e. Number of watersheds with biological and habitat assessment.
f. Number of ambient monitoring sites by ecoregion.
g. Number of sites with biological and habitat assessment by ecoregion.
h. Number of watersheds with ambient, biological, and habitat assessments.
i. Number of watershed water quality models of NPS pollutants developed.

Goal B: Water Quality Improvement and Protection

Improve water quality by implementing NPS-related projects and other activities.

Goal B: Objectives

1. By 2004, 25% of waters listed on the 1998 303(d) list due to NPS pollution will meet water quality standards.
2. By 2014, 75% of waters listed on the 1998 303(d) list due to NPS pollution will meet water quality standards.
3. Reduce potential nonpoint sources of groundwater contamination.
4. Cooperate and collaborate with other resource programs, agencies and private partners to prevent, manage, and reduce nonpoint sources of pollution.
5. Encourage environmental stewardship through information and education.

6. By December 2004, initiate 20 or more locally led watershed projects incorporating water quality protection, restoration, or voluntary TMDL action plans.
7. By 2009, begin implementing at least 20 locally led voluntary TMDL action plans.
8. Support pollution prevention efforts to sustain water quality of outstanding state or national resource waters. (See list in Appendix G)
9. Support pollution prevention efforts to sustain water quality of those waters that are close to meeting the criteria for being placed on the 303(d) list as impacted by NPS pollutants, but have not yet attained that status. (See Section IV, Priority Waters, Paragraph 3)

Goal B: Implementation Strategies

a. Expand eligible uses of the State Revolving Loan fund programs to include prevention or control of nonpoint sources.
b. Designate as top priority for funding assistance those waters included on the 303(d) list as impaired by nonpoint sources.
c. Support programs and training that provide communities and local leaders the tools to plan, fund and direct watershed protection and restoration efforts.
d. Encourage and support locally led watershed projects that incorporate water quality protection, restoration, or voluntary TMDL action plans.
e. Direct funding pursuant to section 319 of the Clean Water Act with maximum flexibility to complement resources available to the watershed from other programs and agencies.
f. Support development and adoption of innovative best management practices through resource management systems.
g. Sponsor water quality information and education programs and materials.
h. Offer technical assistance and cost share assistance as appropriate.
i. Support water quality, NPS issues training and technical certification processes for advisors to the public in related resource areas.
j. Support activities promoting environmental stewardship in the manipulation of land by the developmental, agricultural and silvicultural communities.
k. Actively seek collaborative NPS water quality protection projects that are likely to provide mutual benefits to participants and sponsors.
l. After revision of the Unified Watershed Assessment to make it a more usable tool, target Category I watersheds for voluntary TMDL action plans or WQMP plan implementation.
m. Advise local entities on the appropriate use of urban and suburban stream protection and stormwater sediment control resolutions and ordinances.
n. Promote pollution prevention and protection of waters in projects throughout the state.
o. By 2004, integrate NPSMP goals and objectives into Phase II of the State Water Plan.
p. Develop watershed restoration and protection strategies for priority areas where water quality is degraded by nonpoint source pollution due to karst topography.

Goal B: Evaluation Measures

a. Number of local or regional watershed alliances formed.
b. Number of Special Area Land Treatment (SALT) agricultural NPS water quality projects approved by the Soil and Water Commission.
c. Number of acres treated and best management practices applied as part of watershed projects and voluntary WQMP/TMDL action plans.
d. Number of watershed projects initiated and voluntary TMDL action plans implemented.
e. Number of locally led watershed projects initiated and locally led voluntary TMDL action plans implemented.
f. Number of drinking water reservoirs in compliance with NPS-related drinking water standard.
g. Quantifiable measures on a project-specific basis such as: tons of soil saved, reductions in nutrients and pesticides applied (if appropriate), reductions in pesticides and nutrients leaving the field.
h. Number of nutrient management plans (NMP) implemented at animal feeding operations (AFOs).
i. Number of acres on which nutrients are applied in accordance with an approved NMP.
j. Number or amount of State Revolving Fund loans used to prevent NPS pollution.
k. Number of stream miles and lake acres returned to compliance with water quality standards which were included on the 1998 list of impaired waters prepared under Section 303(d) of the federal Clean Water Act as a result of NPS pollution.
l. Number of potential nonpoint sources of groundwater contamination controlled.
m. Number of educational and informational activities conducted by government and private entities.
n. Number of participants in educational and informational activities.
o. Number of informational and guidance materials developed and distributed.
p. Number of stream teams and Level I, II, and III volunteer monitoring teams.
q. Number of abandoned wells certified as properly plugged.
r. Number of source water protection plans.
s. Number of acres protected by source water protection plans.

Goal C: State NPS Program Management

Maintain a viable, relevant, and effective NPS Management Program with the flexibility necessary to meet changing environmental conditions and regulations.

Goal C: Objectives

1. Review and update the NPS Management Plan (NPSMP) every five years.
2. Strengthen cooperation and collaboration with other resource programs, agencies and private partners.
3. Use appropriate program and financial systems to ensure Section 319 funds are used consistently with legal obligations and environmental benefits are maximized.
4. By 2004 identify federal lands and activities that are not managed consistently with state NPS objectives (see Appendix D).
5. Maintain funding of NPS activities at or above 1999 levels.

Goal C: Implementation Strategies

a. Organize and support meetings that provide a forum for sharing water quality and NPS information and technologies, such as the Water Quality Coordinating Committee, Watershed Committee of the Ozarks and others.
b. Work with local authorities and landowners to achieve goals in the state NPSMP.
c. Capitalize on opportunities to provide input regarding NPS issues to other entities.
d. Incorporate NPS-related goals of other groups and agencies in the NPS Management Program as appropriate and provide complementary assistance in achieving those goals.
e. Review and revise the NPSMP according to the following schedule:
   - Annually review and, if appropriate, revise the assessment and monitoring strategy and funding sources in the NPSMP.
   - Year two, review and update the implementation assistance and regulatory authorities.
   - Year three, review and update remaining categorical sections such as land application of permitted wastes.
   - Year four, review and revise goals and objectives and review legal certification of authority. Complete updates of any sections not revised during the preceding five years.
   - Make appropriate revisions to the NPSMP as needed when changes in environmental conditions or regulatory authorities make the existing plan irrelevant or inappropriate.
f. Use the Water Quality Coordinating Committee and other forums to review, comment, and participate in the NPSMP review and revision.
g. Use the Clean Water Commission and public notice procedures to provide the opportunity for public review and comments to the revised NPSMP.
h. Maintain current information on Grant Reporting and Tracking System (GRTS).
i. Periodic audits conducted.
j. Follow EPA guidelines in reviewing, prioritizing, funding and managing activities funded under section 319 of the Clean Water Act.
k. Suggest improvements to state and federal program guidelines when appropriate to enhance NPS management capabilities.

Goal C: Evaluation Measures

a. NPSMP is reviewed and updated in accordance with preceding schedule.
b. Numbers and diversity of participants involved in the Water Quality Coordinating Committee meetings.
c. Number and diversity of collaborators in development of NPSMP.
d. Number of federal lands or activities inconsistent with the NPSMP and the number of those lands or activities addressed.
e. Status of GRTS reporting.
f. Number of projects closed out properly.
g. Number of MOA's signed between or among partnering entities.
h. Procedural improvements identified and implemented.
i. Amount of state funding directed to NPS activities.
j. Amount of federal funding directed to NPS activities in Missouri.

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Strategic Plan
(Excerpts)

Mission

Preserve and protect the state's natural, cultural and energy resources and inspire their enjoyment and responsible use for present and future generations.

Strategic Issue 1: Protecting Missouri's Water, Air and Land Resources

GOAL: WATER

Continuously preserve and protect the quality and quantity of the water resources of the state of Missouri.

Outcome A

Improved quality of surface water and groundwater in the state.

Outcome Measures

1. Increase in the number of stream miles and lake acres that are safe and useable for drinking, swimming, fishing and watering livestock
2. Reduction in the number of sites where groundwater aquifers are contaminated above drinking water standards

Objective 1

By 2003, increase compliance with minimum water quality standards on: six stream miles currently polluted by animal manure; two stream miles currently polluted by abandoned mine lands; 10 stream miles currently polluted by domestic point source discharges; and 50 lake acres currently polluted by farm herbicides.

Objective Measures

1. Number of stream miles returned to compliance with water quality standards which were included on the 1998 list of impaired waters prepared under Section 303(d) of the federal Clean Water Act as a result of discharges of animal manure, abandoned mine lands, and domestic point source discharges
2. Number of lake acres returned to compliance with water quality standards that were included on the 1998 list of impaired waters prepared under Section 303(d) of the federal Clean Water Act as a result of farm herbicides
3. Compliance with Underground Injection Control and Oil and Gas Council regulations
4. Number of stream miles failing to meet water quality standards due to sedimentation

Strategies

a. Perform Total Maximum Daily Load studies to identify pollution sources and allocate pollution loads. (*NPSMP Goals/Objectives/Strategies A.n.*)
b. Perform special water quality studies to assess source impacts and better understand the interaction of pollutants and the aquatic environment. (*NPSMP Goals/Objectives/Strategies A.b.c.d.*)
c. Develop and propose to the Clean Water Commission numeric biological criteria as a water quality standard in order to identify better those impacted streams incapable of supporting the expected biological community. (*NPSMP Goals/Objectives/Strategies A.3.a.*)
d. Complete revision of the nonpoint source management plan. (*NPSMP Goals/Objectives/Strategies C.1.e.*)
e. Ensure that Missouri water quality meets standards and laws, through permitting, inspection and enforcement efforts. When necessary and appropriate for protection of our natural resources, promulgate new rules.
f. Issue Letters of Approval to guide small animal production operations in best management practices. (*NPSMP Goals/Objectives/Strategies B.4.f.*)
g. Remediate abandoned coal mine lands to reduce water quality impacts from salts and acid-forming materials. (*NPSMP Goals/Objectives/Strategies B.1.b.*)
h. Require remediation of abandoned metallic mineral mine lands to reduce water-quality impacts from metals and particulates. (*NPSMP Goals/Objectives/Strategies B.1.b.*)
i. Support multi-agency efforts to encourage application of Best Management Practices in the watersheds of drinking water lakes impacted by farm herbicides. (*NPSMP Goals/Objectives/Strategies B.3.f.k.*)
j. Through the Special Area Land Treatment program for watersheds, work with landowners to apply best management practices and establish agricultural NPS projects. (*NPSMP Goals/Objectives/Strategies B.3.e.f.*)
k. Maintain interagency coordination and cooperation through the Water Quality Coordinating Committee and participation in other forums. (*NPSMP Goals/Objectives/Strategies C.2.a.*)
l. Issue grants and low-interest loans to assist in the construction of domestic wastewater and animal waste facilities. (*NPSMP Goals/Objectives/Strategies B.3.a.*)
m. Issue stormwater grants and grants to assist with NPS information, education and demonstration activities. (*NPSMP Goals/Objectives/Strategies B.4.c.g.j.*)
n. Monitor compliance with the Underground Injection Control, and Oil and Gas Council regulations to ensure both optimal resource recovery and environmental protection.

Objective 2

Increase compliance with groundwater protection regulations.

Objective Measures

1. Percent of properly abandoned oil and gas wells
2. Percent increase in water wells constructed according to water well regulations and requirements
3. Geologic site evaluations conducted for solid waste disposal, hazardous waste disposal, subdivision waste disposal and potential wastewater lagoons

Strategies

a. Enforce the upgrade requirements for underground storage tanks. (*NPSMP Goals/Objectives/Strategies B.2.*)
b. Require remediation of soil and groundwater contamination by leaking underground storage tanks and hazardous substances. (*NPSMP Goals/Objectives/Strategies B.2.*)
c. Enforce regulations that protect Missouri's groundwater resource including well driller and pump installation, oil and gas regulations, the Clean Water Law and the Cave Resources Act. (*NPSMP Goals/Objectives/Strategies B.2.*)
d. Ensure that facilities are constructed in a manner protective of groundwater resources through evaluation of potential sites for geologic and hydrologic considerations. (*NPSMP Goals/Objectives/Strategies B.2.*)
e. Research and develop a plan for measuring groundwater quality effectively and efficiently throughout Missouri. (*NPSMP Goals/Objectives/Strategies A.2.*)

Objective 3

Increase in the availability, accuracy and understanding of geologic, hydrologic and water use data as it relates to water resources.

Objective Measures

1. Amount of geologic, hydrologic and water use data produced or reported:
    a. Flood studies
    b. Surface, groundwater and spring studies
    c. Watershed modeling studies
    d. Major water users registration
    e. Well logs
    f. Missouri and Mississippi River data
2. Number of water related databases available through a Geographic Information System (GIS)
3. Decrease in percent of error in data retrieval from monitoring equipment
4. Improve tracking of groundwater quality by increasing the number of monitoring wells statewide

Strategies

a. Conduct an analysis of future water demand and water needs on an annual basis.
b. Collect, manage and distribute accurate data regarding the surface and subsurface water of the state and its use. To develop this information, maintain integrated major water user and other technical water resources databases and prepare river

basin and watershed physical information reports. (*NPSMP Goals/Objectives/Strategies A.1,2.e.)*

c. Participate in flood restudy efforts of the Missouri and Mississippi rivers to determine 100-year and other flood stage height changes.
d. Increase surface and groundwater studies describing discharge and recharge areas.
e. Continually examine water laws for changes in legislation and registration needs.
f. Improve monitoring equipment and the retrieval of accurate data from the equipment. (*NPSMP Goals/Objectives/Strategies A.2.e.)*
g. Gather more frequent information from the United States Corps of Engineers and from other states on potential projects that may affect Missouri's water flows.

Outcome C

Drinking water meets all health-related standards

Outcome Measures

1. Increased percentage of Missourians living where drinking water meets government standards (Show-Me Result)
2. Reduction in the contaminant levels in source water

Objective 1

Improve the quality of public drinking water by decreasing the number of significant non-compliers each year.

Objective Measures

1. Increase in the number of public water systems that are sampled on a regular basis and the number of bacterial, chemical and radiological samples analyzed
2. Increase in the number of public drinking water systems that are inventoried
3. Decrease in the number of incidents of waterborne diseases
4. Decrease in the percentage of public water systems with acute violations
5. Decrease in the number of public water systems forced to use alternate or emergency sources of drinking water not identified in standard or emergency operating procedures
6. Decrease in the number of public water systems having to implement extreme water conservation measures

Strategies

a. Maintain a contaminant monitoring program for public water systems in accordance with the Safe Drinking Water Act. (*NPSMP Goals/Objectives/Strategies A.2.e.*)
b. Provide operator training and technical assistance for public water systems. (*NPSMP Goals/Objectives/Strategies B.3.i.*)
c. Provide funding for public water system improvements through grants and loans.
d. Assure adequate construction of drinking water facilities through plan and other engineering reviews, and permitting and construction inspections.
e. Help public water systems protect their source water quality through source water protection programs. (*NPSMP Goals/Objectives/Strategies B.3.c.e.*)

f. Cooperate with state and federal agencies to support NPS pollution control and other source water protection efforts. (*NPSMP Goals/Objectives/Strategies B.3.*)
g. Ensure that public drinking water systems in Missouri are properly managed through permitting, inspection and enforcement efforts. Promulgate understandable, reasonable and workable drinking water rules through the Safe Drinking Water Commission.
h. Promote system consolidation, wholesale water distributors and other mechanisms to provide public water systems with adequate water supplies.
i. Ensure that source issues are adequately addressed in public water systems emergency operating plans.

Objective 2

Improve the quality of drinking water supplies by increasing compliance with the Water Well Drillers Act.

Objective Measures

1. Percentage of water wells submitted for review that are certified
2. Number of water well drillers and pump installers registered

Strategies

a. Ensure compliance with Water Well Drillers Act.
b. Provide training sessions for all drillers and pump installers so that wells are properly constructed and groundwater protection measures installed. (*NPSMP Goals/Objectives/Strategies B.2.i.*)
c. Work with financial institutions to ensure that water wells are certified before any transactions dealing with the sale of land are completed.

Outcome D

Protection of the state's wetland resources

Outcome Measure

Trends in wetland acreage

Objective 1

Effect no net loss of wetland acreage

Objective Measure

1. Number of wetland studies completed and reports issued

Strategies

a. Evaluate wetland health by investigating surface water and groundwater levels, soils saturation, soil characterization, soil evaluations, and by the use of satellite and aerial photography to evaluate changes in wetland acreage. (*NPSMP Goals/Objectives/Strategies A.2.b.*)
b. Increase educational activities regarding wetlands. (*NPSMP Goals/Objectives/ Strategies B.4.g.*)

c. Require mitigation for wetland losses through the water quality certification process.
d. Provide protection of wetlands through purchase of wetland acreage when effective and appropriate for inclusion in the state park system.

GOAL: LAND

Preserve and protect Missouri's land resources for ongoing responsible use.

Outcome E

Reduction in soil erosion on Missouri's agricultural land

Outcome Measure

Increased productivity of Missouri's firms and farms (Show-Me Result) as measured by tons of soil saved

Objective 1

By 2006, reduce soil erosion on 95 percent of Missouri agricultural land to a level at which soil loss does not hinder productivity (i.e. it is tolerable).

Objective Measures

1. Increase in the miles and acres of soil conservation practices constructed
2. Maintain or increase in the number of educational events held by soil and water conservation districts
3. Increase in the number of watersheds with soil conservation practices constructed
4. Increase in the Special Area Land Treatment projects completed utilizing soil conservation treatments

Strategies

a. Create partnerships with agencies involved in soil conservation. (*NPSMP Goals/Objectives/Strategies C.2.a., B.3.*)
b. Expand the department's role in providing technical assistance for soil conservation, and promote land use practices that maximize soil protection. (*NPSMP Goals/Objectives/Strategies B.3.f.h.j.*)
c. Collect and manage data related to soil conservation efforts so that a central source of information is available to all interested parties.
d. Provide training for Soil and Water Conservation District supervisors and employees to maximize conservation efforts and improve fiscal responsibility for the Soils Sales Tax Fund. (*NPSMP Goals/Objectives/Strategies B.3.i.*)
e. Improve fiscal and operational accountability through enhancement of the Soil and Water Conservation District and cost-share accounting system and continuation of audits for the districts.
f. Begin implementation of the initiative to address the water quality issues in the Table Rock Lake watershed resulting from soil erosion and runoff. (*NPSMP Goals/Objectives/Strategies B.5.*)

g. Continue to provide various types of financial assistance to construct and implement soil conservation measures including grants and loans. (*NPSMP Goals/Objectives/Strategies C.5.*)

MISSOURI DEPARTMENT OF HEALTH AND SENIOR SERVICES
Section for Environmental Public Health

Strategic Plan
(Excerpts)

Issue: The lack of a clear legal authority has caused a fragmented public health system within Missouri.

Objective 3

To reduce the public health impact of potentially unsafe private water supplies by developing and implementing a private water supply program by July 2005.

Strategies

1. Develop and implement standards and policies for private water supplies.
2. Establish and enhance a database of existing private water supplies in Missouri.
3. Develop relationships with other interested agencies in promoting the protection of private water supplies. (*NPSMP Goals/Objectives/Strategies B.3.)*
4. Evaluate literature to determine the risk associated with recreational water.
5. Develop educational tools for groundwater safety (brochures, PSA, presentations). (*NPSMP Goals/Objectives/Strategies B.2,4.g.)*
6. Develop a list of financial resources for improvement of private water supplies.
7. Develop a unified set of standards for private water supplies with other interested agencies.
8. Develop training programs for inspectors, financing agents and other interested parties. (*NPSMP Goals/Objectives/Strategies B.4.i.)*
9. Work with SPHL to utilize the most efficient analysis of private water samples.

Objective 4

To increase the surveillance of recreational water to determine the risk to public health and safety by July 2003.

Strategies

1. Develop and implement a study to determine the public health risk associated with recreational water. (*NPSMP Goals/Objectives/Strategies A.2.)*
2. Evaluate health databases to determine risks potentially associated with recreational water.
3. Develop an assessment tool to survey the counties to determine their risks associated with recreational water.
4. Evaluate literature to determine the risks associated with recreational water.
5. Establish statutory authority for the program.
6. Establish standards for safe recreational water. (*NPSMP Goals/Objectives/Strategies A.i.)*
7. Develop model ordinances.
8. Develop and implement rules.

9. Develop tools to educate on what is safe recreational water. (*NPSMP Goals/Objectives/Strategies B.4.g.)*

Issue: All of Missouri's 5.2 million citizens and 35 million visitors are potentially exposed to hazardous substances and environmentally induced diseases.

Objective 9

Increase to 70% the percentage of newly constructed or repaired sewage systems that comply with state standards by July 2005.

Strategies

1. Establish a baseline of newly constructed or repaired sewage systems that comply with state standards.
2. Assure that 100% of permit applications are reviewed for compliance with state standards.
3. Assure installation inspections are conducted on non-registered installers, in compliance with state standards.
4. Provide yearly training for district and local health agency environmental health personnel. (*NPSMP Goals/Objectives/Strategies B.4.i.)*

UNIVERSITY EXTENSION
Environmental Quality and Stewardship

Base Program Plan
(Excerpts)

Thrust: Water Quality

The intent of University Extension's plan of work is to focus on four major areas of concern: 1) drinking water supply, 2) hazardous [toxic] materials, 3) nutrients and bacterial waste, and 4) ground/surface water and watershed protection.

The four-year plan is designed to work in concert with state and federal agencies and to provide a comprehensive matrix of educational programs that are proactive and address all aspects of water quality. This plan calls upon the entire resources of the University and the cooperation of related agencies. It is directed toward all entities and citizens and will generate new data and options to preserve the water resources of Missouri.

An interagency Water Quality Coordinating Committee (WQCC) was established in June 1989, and meets regularly to bring about an effective statewide network dealing with water quality.

To effectively focus on the issue, University Extension has recently organized a Water Quality Focus Team. The team consists of field faculty, state specialists and agency personnel. In addition, numerous state specialists from all campuses are contributing their expertise to this initiative.

Of the four major areas of concern addressed in the Water Quality base program, the greatest programming efforts will relate to effecting best management practices and nonpoint source pollution in agriculture and to the quality of life of rural citizens.

Theme 1: Drinking Water Supply

A. Private Water Supply
Objectives:
1. Obtain statewide data/information on quality of private water supply from ground and surface sources. *(NPSMP Goals/Objectives/Strategies A.2.e.l., B.3.)*
2. By 2000, test and take corrective measures where contamination exists in 10 percent of program clientele's active, private domestic wells, and place 15 percent of these private domestic wells on an annual bacteria testing program. *(NPSMP Goals/Objectives/Strategies A.2.e,h.)*
3. By 2000, inform 20 percent of program clientele with abandoned wells, and ensure that 15 percent of these have taken corrective action. *(NPSMP Goals/Objectives/Strategies B.2.q.)*

4. Instruct 100 prospective new well owners on the state water well construction standards by 2000. Seventy-five percent of the clientele will employ certified drillers and pump installers. *(NPSMP Goals/Objectives/Strategies B.2.i., B.3.k., B.4.f,g.)*
5. By 2000, persuade 25 percent of program clientele to adopt water management practices including Farmstead Assessment (Farm-a-Syst) and Homestead Assessment (Home-A-Syst) which alleviate problems related to water demand, sources, quality and supply. *(NPSMP Goals/Objectives/Strategies B.3.c,f,g,k., B.4.c,f,g,j,k.)*
6. Enhance the 4-H/Youth Water Quality school-enrichment program for 3,800 students in 125 4th to 6th grade classes that will teach the importance of ground and surface water protection and introduce students to Missouri geology and hydrology. *(NPSMP Goals/Objectives/Strategies B.3.d,f,j,k., B.4.f,g,j,k.)*
7. By 2000, inform rural and small town residents in water deficient areas of the state about alternative water sources and conservation measures. Ten percent of the contacts will develop water plans for alternative sources and conservation. *(NPSMP Goals/Objectives/Strategies A.1.e., B.3.b,c,g,j.)*
8. By 2000, plan for 20 watershed alliances to be active in communities served by drinking water reservoirs. *(NPSMP Goals/Objectives/Strategies B.2.c,d,f,g,h,j,k,m., B.3,4,5,6.c,d.)*

Implementation Plan:

1. Continue to test wells and surface supplies to increase the statewide database. Initiate programs to identify sources of contamination and remedial action. Incorporate findings into teaching materials. *(NPSMP Goals/Objectives/Strategies A.2.e,l., B.3.e,f,g,h,k.)*
2. Conduct in-service education for extension staff in support of the objectives. *(NPSMP Goals/Objectives/Strategies B.3.c,f,g,k.)*
3. Develop and expand teaching materials for use by field staff, and expand resource materials for regional specialists to assist communities in planning alternative sources, emergency supplies and water conservation measures. *(NPSMP Goals/Objectives/Strategies B.3.c,f,g,k.)*
4. Develop a reference resource library to aid state and field specialists in program delivery. *(NPSMP Goals/Objectives/Strategies B.3.c,f,g,k.)*
5. Obtain information and data from a statewide network that documents the number and frequency of wells tested, corrective measures taken, abandoned wells identified and plugged, and new wells constructed to DNR standards. *(NPSMP Goals/Objectives/Strategies A.2.e,l.)*
6. Interact with DNR, Department of Health, Natural Resources Conservation Service and local soil and water conservation district (SWCD) boards, related agencies and other organizations to coordinate efforts toward common objectives. *(NPSMP Goals/Objectives/Strategies B.3.c,g,i,j,k.)*
7. Organize demonstrations on how to properly plug wells and promote watershed management. Demonstrations will be in concert with other state agencies and located in concentrated areas of abandoned wells. *(NPSMP Goals/Objectives/Strategies A.2.e,h., B.3.c,g,i,j,k.)*

8. Continue and expand 4-H/Youth school-enrichment programs including “Water Riches” and others in the public schools. Coordinate the Water Resources education program with 75 4-H youth specialists and youth education assistants as liaisons to local schools and youth groups. *(NPSMP Goals/Objectives/Strategies B.3,4.c,d,f,g,h,i,j,k.)*
9. Train community leaders on how to deal with issues and develop alliances for the protection and management of watersheds above drinking water reservoirs. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.c,d,f,g,h,j,k,m.)*

Evaluation Plan:

Cooperate with state agencies in data collection to determine number of wells tested, corrective measures taken, number of wells in annual testing program, number of abandoned well owners taking corrective action, number of clientele using certified drillers, number of schools participating in the water quality enrichment program, and the number of water plans for alternative sources and conservation developed by communities. Use results to measure impact.

B. Non-Community Water Supply

Objectives:

By 2000, convince 15 unincorporated villages, communities, subdivisions, and/or rural districts to develop and/or improve their common water supply.

Implementation Plan:

1. Help form community coalitions to develop water supply, conservation and protection plans through public policy education. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.)*
2. Serve as liaison with state agencies, organizations and the private sector to further develop and/or improve non-community water supplies. *(NPSMP Goals/Objectives/Strategies B.3,4,5,6.c,d,f,g,h.,j,k,m., C.2.a,b,c.)*

Evaluation Plan:

Ask community leaders involved in improving non-community water supplies to identify how extension impacted progress and results of the initiative. Use tabulated results as the basis for evaluation.

C. Community Water Supply

Objectives:

1. By 2000, provide assistance and information regarding upgrading their water supplies to 14 communities with municipal water supplies. Ten communities will respond.
2. Initiate public drinking water watershed management programs in all communities with identified water quality problems according to EPA notice of violation (NOV). *(NPSMP Goals/Objectives/Strategies B.3,4,5,6.c,d,f,g,h,j,k,m.)*

Implementation Plan:

Work with city water planners, mayors, councils, city managers and citizen groups to help them develop public policy, guidelines and long-range plans for improving the source and quality of municipal water supplies.

Evaluation Plan:

Atrazine levels will be reduced and community water supplies will remain in compliance with EPA regulation.

Theme 2: Hazardous (Toxic) Materials

More than 16 million acres of Missouri land produce row crops and forages. Most of these acres are subject to applications of restricted and nonrestricted pesticides. Consequently the potential for water degradation from pesticide use is great if they are applied indiscriminately. Based on 1984 crop-acreage data and average application rates for most commonly used pesticides, an estimated 500,000 pounds of dry and one million gallons of liquid pesticide were applied to crops in southeast Missouri alone. Present use of all forms of pesticides in the households of five million people in Missouri represent a staggering source of hazardous materials that could degrade our water if not applied according to label, used unnecessarily or disposed of improperly.

A. Water Degradation from Pesticides

Objectives:

1. By 2000, train 15,000 farmers and 1,000 commercial applicators on how pesticides can or may interact and move in soils and how to help preserve ground and surface water quality when using pesticides. Training will include sprayer calibration, container/waste product disposal, mixing procedures and safety. Thirty percent of the clientele will adopt better management practices. *(NPSMP Goals/Objectives/Strategies B.2,3,4.c,d,f,g,h,i,j,k.)*
2. By 2000, train and inform 4,000 homeowners and 500 commercial “lawn care” applicators on how improperly applied restricted and nonrestricted pesticides can impact the waters of the state. Twenty percent of the homeowners and 40 percent of the commercial applicators will adopt improved management practices. *(NPSMP Goals/Objectives/Strategies B.2,3,4.c,d,f,g,h,i,j,k.)*
3. Reduce the use of row crop pesticides by 5 percent through expanding the Integrated Pest Management (IPM) program to all crop-producing regions of the state. *(NPSMP Goals/Objectives/Strategies B.2,3,4.c,d,f,g,h,i,j,k.)*

Implementation Plan:

1. Continue the certification pesticide applicators training program using newly developed educational materials. Each extension pesticide educator will be given a video of the program and other training materials. Provide annual in-service education for pesticide educators for update of related issues. Incorporate results of well testing studies to demonstrate the scope of the problem. *(NPSMP Goals/Objectives/Strategies B.2,3,4.c,d,f,g,h,i,j,k.)*
2. Develop and expand application and spraying equipment programs and printed materials that incorporate calibration, safety and proper application techniques for farmers and commercial applicators. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*
3. Develop demonstrations, educational materials and programs to teach farmers about low-volume and low-rate pesticide technology. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*

4. Integrate information pertaining to pesticide use and application into horticulture publications and educational activities. Develop and expand teaching materials related to yard and garden use of restricted and nonrestricted chemicals. Develop materials to be used for seminars and mass media directed toward urban audiences. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*
5. Coordinate faculty from education, chemistry, human environmental sciences, and agriculture in developing a middle school and high school level curriculum on the use of pesticides around the home and farm, the fate of pesticides in the environment and risk assessment. *(NPSMP Goals/Objectives/Strategies B.3,4.c,f,g,j.)*
6. Develop an Integrated Pest Management educational program for consultants in the private sector. Train prospective consultants and assist them in starting consulting services. *(NPSMP Goals/Objectives/Strategies B.3,4.c,f,g,i,j.)*
7. Promote where appropriate the use of biological control agents for pest management in field crops, forages and ornamentals through field demonstrations. Develop new sources of control agents. *(NPSMP Goals/Objectives/Strategies B.3,4.c,f,g,j.)*
8. Conduct an agriculture pesticide use survey for Missouri. Target geographic areas where well water testing projects are being done by university agricultural and civil engineers. *(NPSMP Goals/Objectives/Strategies B.3,4.c,f,g,j.)*

Evaluation Plan:

1. Randomly survey clientele receiving pesticide training (PAT) to determine what practices they adopted.
2. Conduct surveys to document improved management practices adopted by homeowners and commercial lawn care applicators.
3. Measure Integrated Pest Management (IPM) results by the increased number of regions participating. Pre- and post-testing will help determine results of training for NRCS field personnel.

Theme 3: Nutrients and Bacterial Contaminants

Missouri soil types and topography are very diverse, ranging from rolling wind-blown loess and river bottoms to fractured karst topography overlain with shallow, rocky clay and drainage features such as caves and sinkholes. There is no single strategy for educating landowners and residents regarding the potential for water degradation from land application of mineral elements.

Livestock/poultry is a multimillion dollar business in the state. Large numbers of hogs, dairy cattle, poultry and some beef cattle are concentrated in confinement units. The poultry industry is expanding rapidly. The Missouri approach to waste management, designed and implemented by University Extension, DNR and NRCS, has been successful. Successful as the program may be, much can be accomplished in educating producers and developing new ways of utilizing animal and poultry waste to prevent ground and surface water contamination.

Approximately 32 percent of Missourians live in rural settings and have some type of private sewer system. Many of these systems are concentrated in retirement and resort areas around the 358 lakes in the state. Most of the large lakes are located in the Ozark region, which in most

cases offers severely limited soil types and topography for the proper operation of on-site wastewater treatment systems. NRCS has classified a large percentage of Missouri soil as severely limited for siting septic systems. There is a definite need to find new answers to domestic sewage treatment and educate contractors and homeowners regarding site evaluation, proper installation and maintenance.

Many of our smaller communities need to upgrade and expand their present sewage systems, but are limited in expertise and funds to expedite needed changes. Extension community development specialists can play an active role in planning water quality protection.

A. Water Degradation by Animal/Poultry Waste

Objectives:

1. By 2000, train 1,200 poultry and livestock producers in the best management practices for land application of manures to balance crop nutrients and prevent runoff. Fifty percent of the clientele will begin development and implementation of total nutrient management systems that will meet guidelines set forth by the DNR. *(NPSMP Goals/Objectives/ Strategies B.2,3,4.b,c,d,f,g,j,k.)*
2. Train 30 consultants and technicians in the private sector by December 2000. Participants will be able to assist livestock and poultry producers in the technical design of facilities and structures that will bring them into compliance with state and federal regulations governing manure application and management. *(NPSMP Goals/Objectives/ Strategies B.2,3,4.i.)*

Implementation Plan:

1. Organize a data collection system. Work with selected producers and poultry companies to monitor litter/manure quantities and nutrient concentrations. Develop guidelines to maximize land utilization of nutrients while protecting water resources. Procure or develop a Windows-based, "farmer friendly" computer program that simplifies the task of nutrient management on farms. *(NPSMP Goals/Objectives/Strategies B.2,3,4.c,d,f,g,j,k.)*
2. Develop and expand teaching materials on best management practices for land application of manures to support regional specialists in program delivery.
3. Offer a training course to educate interested consultants and technicians that will qualify them to offer technical design services on animal and poultry waste management facilities. This service will help producers qualify for letters of approval *(permits)* from DNR and result in better construction of manure containment structures.
4. Provide producers with information on the effect of swine waste on water resources and updates on state and federal regulations.

Evaluation Plan:

Document the number of waste management plans impacted by Extension education programs and the number of consultants and technicians trained to assist producers.

B. Water Degradation by Mineral Elements (Plant Nutrients)
Objectives:

1. Develop a database by 2000 to determine the sources and extent of contamination in ground and surface water related to application of crop fertilizers. *(NPSMP Goals/Objectives/Strategies A.2.e,h.)*
2. By 2000, ensure that 30 percent of program clientele understand and are taking advantage of the nitrogen fertilizer replacement value of crop rotations (soybeans, alfalfa, clovers) on the succeeding crop that requires nitrogen. Nitrogen use will be reduced 20 percent for those farmers participating in this management practice. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,j,k.)*
3. By 2000, ensure that 40 percent of program clientele understand the value and limitations of nitrogen soil tests to better predict the nitrogen needs of a crop. This represents about 5 percent of the cropped acreage in a non-drought year. Nitrogen use will be reduced 10 percent by farmers using the management practice. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,j,k.)*
4. By 2000, help Missouri farmers reduce unnecessary use of non-nitrogen mineral fertilizers 10 percent through a better understanding of phosphorus, potash, and secondary and micro nutrient "crop sufficiency" needs. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*
5. By 2000, inform Missouri farmers about the benefits of precision farming. Nitrogen input will be reduced by 10 percent on crops managed by precision farming. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*

Implementation Plan:

1. Review available data. Set up a data collecting program to include the following: 1) product form (liquid, vapor, dry); 2) methods of application, e.g., anhydrous applicators, surface application with no-till planting systems, incorporation with moldboard plow or chisel, deep banding and chemigation. Research and monitor the residual chemicals and determine best management practices. *(NPSMP Goals/Objectives/Strategies A.2.e,h.)*
2. Develop teaching materials to assist regional specialists in meeting the objectives. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,j,k.)*
3. Set up demonstration plots to show the advantages of reduced nitrogen application on crops succeeding legumes. Publish results for use in farmer meetings and mass media. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*
4. Set up demonstration plots to show the value of a nitrogen soil test during the growing season to better predict actual crop needs. Publish results in usable forms for farmer meetings and mass media. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*
5. Educate landowners, faculty and crop consultants on precision/site specific farming using five on-site demonstrations across the state. *(NPSMP Goals/Objectives/Strategies B.2,3,4.)*

Evaluation Plan:

Survey clientele in selected counties to determine nitrogen reduction as a result of planned crop rotations and soil testing. Analyze fertilizer sales in those counties to determine trends in potash and phosphorus usage.

C. Water Degradation by Domestic Sewage

Objectives:

1. Work with the Missouri Department of Health to implement a state certification program for private domestic sewer contractors and backhoe operators by 1998. The underlying objective is to protect water resources in geologically sensitive areas of the state. *(NPSMP Goals/Objectives/Strategies B.2,3.f,g,h,i,k.)*
2. By 1998, inform local officials, developers, realtors, lenders and contractors about properly constructed disposal systems and nontraditional methods. Two hundred participants will adopt and/or recommend best construction practices protecting water resources. *(NPSMP Goals/Objectives/Strategies B.2,3,4.d,f,g,i.)*
3. By 2000, inform 30 percent of rural residents on private sewer systems about the impact of malfunctioning systems on water resources. Fifteen percent of those informed will maintain and/or install proper systems. *(NPSMP Goals/Objectives/Strategies B.2,3,4.d,f,g,i.)*

Implementation Plan:

1. Continue refining a training series, in concert with the Missouri Department of Health and teach workshops that will prepare sewer contractors for certification. *(NPSMP Goals/Objectives/Strategies B.2,3.f,g,h,i,k.)*
2. Develop a "rural wastewater conference" teaching package that can be orchestrated by regional specialists. Conference materials will include agenda, teaching materials, visual aids, reference materials for participants and a list of qualified and available presenters. Primary audience would be public officials, lenders, developers, realtors, contractors, plumbers and plumbing suppliers. *(NPSMP Goals/Objectives/Strategies B.2,3,4.d,f.)*
3. Produce teaching materials to be used by regional specialists to instruct clientele on properly designed and constructed septic systems and alternative methods. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*

Evaluation Plan:

Survey homeowners and commercial interests to determine changes they have made due to Extension programming.

Theme 4: Surface/Groundwater and Watershed Protection

Soil conservation programs have been in place for years, yet certain parts of the state have been classified as having the second worst soil loss problems in the U.S. More than 16 million acres of forage and cropland must be protected from erosion. Six million of those acres are considered highly erodible. Farmers will need information to implement their conservation plans to comply with the Federal Agriculture Improvement and Reform (FAIR) Act of 1996.

To maintain or increase the quality of surface water and the benefits of important watershed components, protection, management and public education are needed. Parks, Recreation and Tourism in the School of Forestry, Fisheries and Wildlife at the University of Missouri-Columbia has access to research data and management techniques relating to wetlands, forest lands, and other watersheds and their relationships to water quality. Major research programs deal with developing best management practices on wetlands and forest lands and with water quality and management relating to rivers, streams, lakes and ponds. Pesticide impacts on water

quality and fish and wildlife resources is another strength of the School of Forestry, Fisheries and Wildlife. A close working relationship exists between the School and most of the agencies and private organizations concerned with the protection and management of the state's natural resources.

Of the 600,000 acres under irrigation in Missouri, 80 percent are located in the southeast corner of the state. Fewer than 10 percent of the irrigators use scheduling methods to determine the proper time to irrigate. In addition, chemigation (application of chemicals through irrigation) has been added to systems throughout the state and more are anticipated. Many systems lack proper safety devices to prevent backflow contamination. There is likelihood of leaching substantial quantities of chemicals into groundwater due to using too small of a stream in furrow irrigation. This problem is worsened by the use of "lay-flat" plastic pipe instead of high-pressure, rigid, gated-pipe. Very few tail-water recovery systems are used in the state. Countless well heads are not properly protected from surface water entering the aquifer around the casing. It is estimated there may be as many as 100,000 substandard wells in Missouri as set forth by the DNR.

A. Soil Erosion and Sedimentation

Objectives:

1. By 2000, help 60 percent of Extension clientele with highly erodible land use conservation tillage or other land management practices to help them carry out their conservation plan as mandated by the 1996 FAIR Act. Three million acres will be in compliance. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
2. Encourage 90 percent of regional Extension specialists who are county soil and water conservation district secretaries to take an active leadership role in district activities to promote conservation of soil and water. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k,m.)*

Implementation Plan:

1. Expand the Extension Conservation Education Workshop to include information on the impact of crop residues on erosion, the effect of implement design on crop residues, fertilizer and weed control methods for no-till and ridge till planting systems, and cover crops for residue enhancement. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,i,j,k.)*
2. Cooperate with NRCS, FSA, Missouri Department of Conservation (MDC) and other agencies to develop educational materials and programs to help clientele increase the application of best management practices affecting their respective farm plans. *(NPSMP Goals/Objectives/Strategies B.1,2,3,4,5,6.c,d,f,g,h,i,j,k,l,m.)*
3. Produce guide sheets, slide sets and videos for regional specialists to use in educating land owners on best management practices to save soil and water.
4. Organize and conduct on-site field demonstrations on construction and maintenance of terraces, waterways, ridge-tillage and contour strip-cropping, operation and adjustment of no-till planters and drills, and measuring residue. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,i,j,k.)*

Evaluation Plan:

Tabulate the number of landowners assisted through training and identify acres affected. Compare against the objectives.

B. Irrigation, Chemigation, Well Development

Objectives:

1. By 2000, ensure that 20 percent of the irrigators in the state will employ some scientific method of scheduling time of irrigation. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,i,j,k.)*
2. By 2000, inform 200 irrigators about well head protection, tail-water recovery, chemigation safety, furrow irrigation and the use of lay-flat plastic pipe for gated pipe. Fifty percent of the participants will make changes in their management practices. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,i,j,k.)*

Implementation Plan:

1. Continue to support the Missouri Irrigation and Water Management Association and provide members with educational activities. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,i,j,k.)*
2. Continue the Annual Irrigation Conference during Ag Science Week. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,i,j,k.)*
3. Develop guide sheets and visuals to assist regional specialists with short courses and conferences. *(NPSMP Goals/Objectives/Strategies B.2,3,4.g,h,i,k.)*
4. Assist regional specialists with conducting tours and meetings on: 1) properly sizing flow for furrow irrigation; 2) tail-water recovery systems; 3) using scheduling to optimize water usage; and 4) chemigation safety. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,i,j,k.)*
5. Continue to work with NRCS and the Department of Atmospheric Science in the College of Agriculture, Food and Natural Resources at the University of Missouri-Columbia on expanding a weather station network for irrigation scheduling by seeking funding and disseminating information. *(NPSMP Goals/Objectives/Strategies B.2,3,4.g,h,i,k.)*
6. Work with NRCS, DNR, chemical companies and irrigation equipment suppliers to develop a training school for those involved in construction of irrigation wells. The training school will emphasize proper well construction/pump installation, well head protection, plugging abandoned wells and the potential hazards of chemigation to water quality. *(NPSMP Goals/Objectives/Strategies B.2,3,4.g,h,i,j,k.)*

Evaluation Plan:

Survey irrigators on use of scheduling methods, tail-water systems constructed, chemigation safety devices installed and other management practices. Compare with the objectives.

Thrust: Natural Resources and Environmental Management

Stewardship of Missouri's natural resources is vital for a sustainable future and high quality of life. Water resources provide for many uses and are dependent on watershed and ground and surface water protection. Biological resources provide for viable ecosystems that support biological diversity and wildlife habitat, as well as provide hunting, fishing and other outdoor recreational opportunities. The sales tax supporting conservation programs demonstrate that Missourians continue to expect improved management of these natural resources. They expect a safe and healthy environment and an agriculture that protects and enhances air, soil and water quality. Wise use and proper management of natural resources will provide Missourians with a continuing high quality of life and a sustainable agricultural system.

University Extension must build a system-wide commitment to education in natural resources and environmental management and provide an educational process to help Missouri citizens make decisions and take actions that will improve the quality, productivity and sustainability of natural resources. Four broad themes have been developed to address natural resources and environmental management programming for youth and adult audiences and include the following:

1. Integrated environmental and agriculture systems management
2. Watershed and surface/ground water protection
3. Biological resources
4. Environmental stewardship

County futuring sessions and statewide surveys have helped verify that environmental concerns and stewardship of natural resources are important to Missourians. Educational programs are needed that focus on ecological principles and processes, the links between individual actions and impact on local and global environments, improved decision-making skills, and an understanding of how stewardship of natural resources enhances resource sustainability, economic viability and improves the quality of life. As a result of the State-Level Program Implementation Conference, a Natural Resources and Environmental Management educational thrust was developed for the Environmental Quality and Stewardship base program.

Objectives:

1. Increase appreciation and understanding in adult and youth audiences of biological resources and native ecosystems, including why a diversity of plants, animals and ecosystems are important. Also increase awareness of unique species or species groups that are in need of conservation. By 2000, 10,000 persons will participate in this program. *(NPSMP Goals/Objectives/Strategies B.2,3,4.d,f,g,h.)*
2. Help make Missouri's agricultural producers more aware of the need for an integrated systems approach to natural resource management. *(NPSMP Goals/Objectives/Strategies B.2,3,4.d,f,g,h.)*
3. Enable agricultural producers, citizens, educators and natural resource professionals participating in integrated environmental and agricultural ecosystem workshops to voluntarily implement conservation practices and habitat enhancement techniques on

their farms or ranches, or in their businesses, municipalities or communities. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.c,d,f,g,i,j,k,m.)*

4. Increase public awareness of the importance of watershed stewardship, the benefits of wetland habitats and water quality. By 2000, educational events will reach 5,000 participants. *(NPSMP Goals/Objectives/Strategies B.2,3,4.d,f,g,h.)*

Anticipated Results/Impacts:

1. Establish greater visibility for current programs associated with natural resources and environmental management. By 2000 there will be a 10 percent increase in the number of participants in the Stewardship, Agroforestry and Natural Resource Youth Programs.
2. Develop an array of educational programs that integrate environmental and ecosystem management strategies to promote an environmentally sound agriculture. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k,m.)*
3. Enhance multi disciplinary Extension programming on issues such as biodiversity, wildlife habitat and damage management, endangered species protection, wetlands restoration and protection, agricultural and forestry production, outdoor recreation and tourism and rural and urban community revitalization. The Extension Conservation Education Workshop will be expanded to include research-based information on these topics. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
4. Develop educational programs that: 1) inform landowners of profitable alternatives for managing forests, fish and wildlife on their property, and 2) increase the number of acres where biological resources are integrated into land management objectives. By 2000, one hundred landowners will establish alternative resource projects on their properties. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
5. Develop a watershed stewardship network for communication and information related to stewardship of natural resources. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k,m.)*
6. Improve the delivery of educational programs in whole-farm planning and integrated farming systems that: 1) are environmentally sound and resource conserving, and 2) increase forest, fisheries and wildlife productivity and profitability on a sustained yield basis. By 2000, five hundred farms will implement improved natural resource management practices on 50,000 acres. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
7. Develop educational programs that demonstrate the economic and conservation values of agroforestry systems. By 2000, develop 10 demonstration agroforestry areas on public and private lands which will result in 1,000 acres of agroforestry program. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
8. Define environmental stewardship issues and improve natural resources and environmental management decision-making skills in youth and adult audiences. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k,m.)*

Theme 1: Integrated environmental and agricultural systems management

More than 16 million acres of Missouri land produce row crops and forages. The challenge to successfully sustain agricultural systems that are profitable and do not damage the state's diverse natural resource base is critical to Missouri's future environmental and economic well-being.

Objectives:

1. Develop and disseminate best management practices for an integrated systems approach to natural resource management. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
2. Teach resource professionals, Extension educators and producers the best management practices and inform them of the need for an integrated systems approach to natural resource management. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
3. Expand public knowledge, understanding and support of the positive interrelationship between agriculture and the environment. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k,m.)*
4. Provide leadership for the enhancement, conservation and protection of Missouri's environment and biodiversity through ecosystem management. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
5. Enhance multi disciplinary Extension programming on issues such as air, water, soil, solid waste, biodiversity, wildlife and habitat enhancement and control, endangered species protection and agricultural production, and rural and urban community revitalization.
6. Work with local, state, regional and federal agencies, private entities, citizens and agricultural and natural resource groups to resolve environmental issues. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k,m.)*
7. Support Sustainable Agriculture base program action plan. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*

Implementation Plan:

1. Develop educational programs that integrate environmental and ecosystem management strategies to promote an environmentally sound agriculture.
2. Support environmental education awareness and action projects at community levels that encourage partnerships and support facilitation of environmental and natural resource conflict resolution.
3. Increase interaction and cooperation with federal and state agencies, advisory groups, and organizations for the purpose of addressing emerging issues, regulatory and policy requirements, and new legislation and to expand delivery of helpful information to landowners and other interested users.
4. Develop educational materials and curriculum that increase citizen understanding of the array of benefits that result from investments in habitat enhancement and management of fish and wildlife resources. Also show the potential incentives from making recreational access to these resources available to diverse groups of users. By 2000, educational events will reach five hundred participants in this program.

Evaluation Plan:

1. Determine if 75 percent of Missouri's agricultural producers have been made aware of the need for an integrated systems approach to natural resource management.
2. Determine if 25 percent of the agricultural producers, citizens, educators and natural resource professionals participating in integrated environmental and agricultural ecosystem workshops can voluntarily implement conservation practices and habitat enhancement techniques on their farm, ranch or in their business, municipality or community.

Theme 2: Surface/groundwater and watershed protection

Surface water covers 2 percent of Missouri and includes 56,000 miles of streams and rivers, 14 major reservoirs that encompass more than 315,000 acres, 300,000 ponds and lakes covering 250,000 acres, and more than 1,100 recorded springs. These 900,000 total acres of water provide many ecological and economic benefits to Missourians. However, this resource continues to be subject to runoff from a wide spectrum of watersheds ranging from cultivated river hills and bottom land to the forested Ozarks.

Approximately 29 percent of this watershed area is forest land. Wetlands are another important watershed component in need of restoration and protection. For example, of the original 2.4 million acres of bottom land hardwood forests in southeast Missouri, less than 60,000 acres, or 2 percent, remain today. According to wetland inventory data, 95 percent has been totally eliminated through channelization, tributary modifications, urban development and industrial encroachments. Surface and subsurface drainage has also eliminated wetlands and resulted in increased sediment from soil erosion filling lakes and streams.

Objective:

Develop educational programs that establish the relationship between wise land and watershed stewardship and economic and social factors such as tourism, community development potentials, land values, maintaining biological diversity and quality of life.

Implementation Plan:

1. In collaboration with the Water Quality Focus Team and partners, develop educational materials to support programs that teach and demonstrate best management practices for habitat management, water management and watershed protection. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
2. In target watersheds, provide localized best management practice recommendations for reducing agricultural pesticide runoff. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.c,d,f,g,i,j,k,m.)*
3. Create public awareness of the importance of water quality for fisheries and wildlife resources. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
4. Conduct educational programs focusing on protection of water quality and fisheries and wildlife habitat using stream stewardship techniques and proper management of riparian buffer zones. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*

Evaluation Plan:

1. Determine number of acres enrolled in streams for the future programs and stream stewardship incentive programs.
2. Determine number of acres impacted by watershed alliances and other watershed stewardship programs as a result of educational and technical assistance opportunities.
3. Conduct baseline and follow-up surveys to determine changes in watershed stewardship knowledge, opinions and attitudes.
4. Determine number of acres enrolled in wetland restoration and protection programs.

Theme 3: Biological Resources

Supplies of fish and wildlife are influenced by changing land and water uses. In Missouri, approximately 95 percent of the diverse land base is privately owned. The future of fisheries and wildlife conservation depends to a large extent on the land-use decisions made by landowners. Expanded educational programs are needed to enable landowners and managers to make informed decisions regarding the wise stewardship and conservation of fish and wildlife resources. More than 70 percent of the five million Missouri residents have participated in fish and wildlife activities. The demand for wildlife and fisheries resources from private lands, as well as for associated economic and recreational opportunities, continues to increase.

Missouri has more than 13 million acres of forest land. *(While professional foresters view this land as)* producing less than one-half of its potential for wood products (*newer technologies such as chip mills and whole log exportation may rapidly increase forest output*). Educational programs combined with on-the-ground technical assistance are needed to create awareness of the potentials for improved income, reduced energy costs, enhanced wildlife habitat, reduced soil erosion, improved water quality and other benefits that can be improved through proper forest resource management practices. Less than 15 percent of the 200,000 private landowners apply any intensive woodland management or use the professional forestry services available to them.

Objectives:

1. Increase the number of acres where biological resources are integrated to provide compatible and beneficial functions and ensure the diversity of native wild plants and animals. By 2000, four hundred landowners will integrate management of biological resources into their land management objectives. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
2. Increase appreciation and understanding in adult and youth audiences of biological resources and native ecosystems, including why a diversity of plants, animals and ecosystems is important. Also increase awareness of unique species or species groups that are in need of conservation.
3. Increase acres devoted to agroforestry systems by 10 percent and increase the number of landowners incorporating a forest stewardship plan and improving the forest resource through proper management. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
4. Increase multi disciplinary program planning for management of agricultural, forest and urban lands and waters that provide landowners with profitable alternatives for managing forest, fish and wildlife on their lands to meet individual or community objectives. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k.)*
5. Improve the delivery of educational programs in whole-farm planning and integrated farming systems that are environmentally sound, resource conserving and that increase forest, fisheries and wildlife productivity and profitability on a sustained yield basis. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*

Implementation Plan:

1. Develop in-service education opportunities, programs, workshops, publications and other educational materials to show how Missouri citizens can increase the integration of biological resources into their land management activities. *(NPSMP Goals/Objectives/ Strategies B.2,3,4.f,g,i,j,k.)*
2. Develop educational materials explaining: 1) the ecological importance of, 2) the economic benefits of, and 3) how and where to establish agroforestry plantings. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
3. Develop educational materials and programs that demonstrate conservation of prairie and wetland ecosystems. Collaborate with partners to deliver educational activities designed to conserve these ecosystems. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
4. Collaborate with partners to facilitate holistic and workable management approaches on private lands, acreages, backyards and other landscapes. *(NPSMP Goals/Objectives/ Strategies B.2,3,4,5,6.c,d,f,g,i,j,k.)*
5. (Not Applicable to NPS)
6. Develop educational programs that encourage people to commit to helping improve the environment. Monitor actions taken as a result of these commitments. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.c,d,f,g,i,j,k.)*
7. Develop in-service training programs, workshops, publications and other educational approaches that illustrate the interdependencies among agriculture, natural resources and people; that foster a stewardship ethic; and that explain the meaning and importance of ecosystem management and biological diversity. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.c,d,f,g,i,j,k.)*
8. Develop educational materials and conduct training workshops for audiences designed to decrease wildlife damage and human/wildlife conflicts by using cost-effective technologies to prevent and control economic losses, property damage and potential health hazards caused by problem wildlife.

Evaluation Plan:

1. Survey number of acres enrolled in habitat incentive programs, number of conservation practices implemented as a result of educational programs, and technical assistance opportunities offered through federal, state and private organizations. Determine the number of farms and individuals who adopt practices that enhance long-term conservation of biological resources.
2. Conduct baseline and follow-up surveys to determine changes in biological resources stewardship, knowledge, opinions and attitudes.

Theme 4: Environmental Stewardship

County futuring sessions and statewide surveys have helped verify that environmental concerns and stewardship of natural resources are important to Missouri citizens. These include water quality; solid, hazardous, animal and human waste disposal; the safe use of pesticides; and the need for increased conservation of the natural resource base.

Objective:

Increase understanding in adult and youth audiences of how stewardship of natural resources improves the quality of life and enhances resource sustainability and economic viability.

Implementation Plan:

1. Along with partners, gather additional baseline information to determine the primary natural resource and environmental management issues Missourians consider important, environmental stewardship, quality of life and economic sustainability. Determine extent of their knowledge, opinions and attitudes about these issues.
2. Develop educational programs and materials for youth and adults that focus on ecological principles and processes, the links between individual actions and impacts on local and global environments, and improved decision-making skills based on environmental stewardship. By 2000, 1500 youth and adult leaders will participate in wildlife habitat evaluation educational programs. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*
3. Develop educational programs that motivate landowners to improve land stewardship capabilities and provide information on technical assistance and habitat incentive programs. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k.)*
4. Prepare educational materials for all age groups designed to highlight environmental stewardship issues and improve natural resource and environmental management capabilities. *(NPSMP Goals/Objectives/Strategies B.2,3,4,5,6.b,c,d,f,g,i,j,k.)*

Evaluation plan:

Conduct baseline and follow-up surveys to determine changes in environmental stewardship knowledge, opinions and attitudes.

Thrust: Solid waste

Theme: Compostable Waste Disposal

Environmental issues such as solid waste disposal and proper application of animal waste are important parts of many county plans. Missouri is a leading state nationwide in terms of animal agriculture and *(could)* continue to be progressive given a *(cooperative)* climate that encourages new methods of animal waste handling and disposal. One alternative to conventional methods of disposal for solid and animal wastes is the use of composting. This method can result in reduction in organic waste entering the waste stream and provide an end product that will be easier to handle than conventional animal waste systems.

Objectives:

1. Determine the economic feasibility of using composting methods to dispose of solid and animal waste.
2. Develop models of alternative waste handling systems that are feasible for individual livestock producers to incorporate into existing facilities.
3. Encourage development of new markets to make use of the end products from these alternative systems.

4. Reduce amount of solid waste entering the waste stream.
5. Collect research data to ensure that new procedures are environmentally sound.

Implementation Plan:

1. Develop models and collect data of systems that will be used on individual animal facilities.
2. Gain recognition from regulatory agencies that alternative methods of animal waste disposal are environmentally safe.
3. Determine portions of the solid waste stream that can be incorporated into these models.
4. Analyze byproducts from the alternative waste disposal systems for uses and environmental consequences.
5. Determine alternative markets for the end product.
6. Encourage producers to adopt alternative systems of animal waste disposal that are economically feasible and environmentally friendly. *(NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,i,j,k.)*

Evaluation Plan:

Determine the amount of waste diverted from the solid waste stream, number of producers adopting new technologies and markets developed for byproducts produced.

MISSOURI DEPARTMENT OF AGRICULTURE

Strategic Plan
(Excerpts)

II. PUBLIC HEALTH AND THE ENVIRONMENT

Issue:
The public benefits of U.S. agriculture over the last fifty years have been tremendous: unequaled food safety and food quality, the lowest food costs in the world, improved human health, large trade surpluses, products made from renewable resources, and increased environmental sustainability. However, despite these widespread improvements, the public is increasingly concerned about environmental and food safety issues. The ability to satisfy the public's need for food, shelter and clothing must be balanced with the need to protect public health, the environment, and agricultural resources.

Goal:
To protect, preserve, and promote public health, the environment, and agricultural resources.

Outcome A:
Prosperous and sustainable livestock and poultry production.

Outcome Measures:
1. Number of dollars of new investment in environmental practices and collection/processing activities as a result of the Animal Waste Treatment System Loan Program. (*NPSMP Goals/Objectives/Strategies B.2,3.a,b,e.*)
2. Number of livestock producers able to obtain low-cost financing as a result of the Animal Waste Treatment System Loan Program. (*NPSMP Goals/Objectives/Strategies B.2,3,4.a,b,e.*)
3. Number of improper dead animal disposal cases.
4. Number of livestock source pollution violations.
5. Percentage of livestock producers utilizing nutrient management plans. (*NPSMP Goals/Objectives/Strategies B.2,3,4.c,d,e,f,h,j.*)

Animal Waste Treatment Objective:
Originate loans for animal waste treatment systems in amounts of $1,000,000 in fiscal years 1999, 2000 and 2001.

Strategies:
1. Network with lenders, commodity groups, banking associations and appropriate state and federal agencies involved in construction of animal waste treatment systems to promote the program. (*NPSMP Goals/Objectives/Strategies B.2,3.a,b,c,d,h,j.*)
2. Encourage lenders participating in the Authority's loan-guarantee program to refer, when appropriate, livestock and poultry producers to the Authority for participation in the Authority's Animal Waste Treatment System Loan Program, reducing the risk for the lender and reducing the interest rate for the producer.

3. Investigate utilization of the Department of Agriculture's Internet home page to make animal waste program information and applications available. (*NPSMP Goals/Objectives/Strategies B.2,3,4.c,g.)*
4. Investigate linkage of other lender associations' and commodity groups' home pages and the Department of Agriculture's Internet home page.
5. Collaborate with other MDA divisions to provide information at appropriate marketing events and utilize all other available resources to promote program.

<u>Dead Animal and Nutrient Management Objectives:</u>

1. Decrease the number of improper dead animal disposals by 30 percent (i.e. from 288 cases to 200) by July 2001. (*NPSMP Goals/Objectives/Strategies B.2,3.c,d,f,j.*)
2. Decrease livestock agriculture source pollution violations by 33 percent (i.e. from 21 to 14) by July 2001.
3. Increase the number of producers utilizing nutrient management plans by 25 percent by July 2000. (*NPSMP Goals/Objectives/Strategies B.23,4.c,d,e,f,h,j.)*

<u>Strategies:</u>

1. Inform and educate producers of laws governing the disposal of dead animals. (*NPSMP Goals/Objectives/Strategies B.2,3,4.g.*)
2. Inspect rendering plants, substations and trucks for compliance with Chapter 269.
3. Assist producers in observing nutrient management plan guidelines. (*NPSMP Goals/Objectives/Strategies B.2,3.d,f,h,i,j.*)
4. Provide technical assistance to new animal production facilities to make sure they comply with environmental laws. (*NPSMP Goals/Objectives/Strategies B.2,3,4.e,d,f,g,h,i,j.*)

<u>Outcome D:</u>
Proper use of pesticides.

<u>Outcome Measure:</u>
Percentage of investigations/inspections verifying compliance with pesticide regulations. (Targets: Registration = 100%, Certification = 100%, Application = 100%).

<u>Objective:</u>
To annually maintain compliance rates of inspections involving licensing, registration, mixing, storing, disposal and application of pesticides at or above 95%.

<u>Objective Measure:</u>
Number of verified violations involving licensing, registration, mixing, storing, disposal, and/or application of pesticides.

Strategies:

1. Work closely with University Extension and the U.S. Environmental Protection Agency in developing and maintaining pesticide applicator training programs for certification and recertification of pesticide applicators. (*NPSMP Goals/Objectives/Strategies B.4.g,i,j.*)
2. Work closely with University Extension to develop and maintain study manuals for training and examinations. (*NPSMP Goals/Objectives/Strategies B.4.g,i,j.*)
3. Continually review and revise pesticide applicator and dealer examinations based upon the standards of competence defined in the Missouri Pesticide Use Act.
4. Offer pesticide applicator and dealer examinations throughout the state a minimum of 35 times per year.
5. Issue pesticide applicator and dealer licenses in a timely manner.
6. Annually establish the minimum number of pesticide inspections to be completed for the following: commercial applicator licenses; commercial applicator records; pesticide technician licenses; pesticide technician training records; pesticide technician training programs; noncommercial applicator licenses; noncommercial applicator records; public operator licenses; public operator records; dealer licenses; dealer records; use; and direct supervision.
7. Register pesticides offered for sale in the state and maintain current labels on file.
8. Utilize computer and software capabilities to develop and maintain databases to improve program development, efficiency, and decision making.
9. Draft and seek approval from the U.S. Environmental Protection Agency for State Management Plans pertaining to the use of certain pesticides in the state.
10. Design and Implement pesticide worker protection program activities as prescribed by the U.S. Environmental Protection Agency.
11. Design and implement endangered species protection programs in accordance with guidelines of the U.S. Environmental Protection Agency.
12. Annually review and make necessary revisions to the Pesticide Program Enforcement Response Guidance and Civil Penalty Matrix in cooperation with the Environmental Protection Agency. (*NPSMP Goals/Objectives/Strategies B.2,3.*)
13. Investigate feedstuffs suspected to be adulterated with pesticides, poisons and deleterious substances.

Outcome E:
Reduced reliance on non-renewable resources in agricultural production.

Outcome Measure:
Percent reduction of non-renewable resources used in active agricultural production projects.

Objective:
To increase the number of farmers and acres of farmland adopting sustainable agriculture strategies as a result of this program from 20 to 200 farmers and from 1000 to 10,000 acres by December 2001.

Strategies:

1. Provide incentive for participation through demonstration project awards to Missouri farmers annually (23 in 1999).
2. Develop agricultural technologies and farm management strategies which provide incentive (both economic and environmental) to all farmers, especially those who have not participated in the program. (*NPSMP Goals/Objectives/Strategies B.2,3,4.f,g,h,j.*)
3. Establish a more effective means of reaching farmers who have not participated in the program (radio, direct mail, University Extension offices, etc.).
4. Enlist the cooperation of local University Extension personnel in promoting participation in the program. (*NPSMP Goals/Objectives/Strategies B.3.k.*)
5. Ensure all agricultural areas of the state are represented in the program.
6. Develop a plan for informing local farmers and residents when and where field days and tours will occur. (*NPSMP Goals/Objectives/Strategies B.3,4.b,c,d,e,g,k,j.*)
7. Publicize conferences to increase attendance.
8. Maintain educational information in University Extension offices. (*NPSMP Goals/Objectives/Strategies B.3,4.c,d,e,g,j.*)
9. Develop a summary of each completed project and publish within one year of completion.
10. Distribute summaries to all interested persons upon request.
11. Have a project summary available at all meetings, conferences, etc.
12. Ensure that each project has some type of educational outreach activity annually (field days, literature, etc.). (*NPSMP Goals/Objectives/Strategies B.3,4.c,d,e,g,j.*)

MISSOURI DEPARTMENT OF CONSERVATION

Strategic Plan
(Excerpts)

Public Land and Water
Public land and water are important for managing fish, forest and wildlife resources and providing associated uses. Public ownership provides opportunities to dedicate areas for specific management activities and uses. Moreover, sensitive or critical resources can be protected, restored, and enhanced through direct regulation of public access or use. Well managed Department lands and waters should provide the best examples of what is possible under various conditions, and should serve as demonstration areas for interested citizens.

Goal I
Protect, sustain, enhance, restore or create fish, forest and wildlife communities on department and other public land and water consistent with regional needs, resource capabilities and authorities.

Objective I.3
Encourage agencies and organizations to protect, sustain, enhance, restore, or create representative fish, forest and wildlife communities on land and water under their jurisdiction.

Strategies:
a) Seek cooperative agreements with other agencies that capitalize on combined resources (i.e., personnel, expertise, and funding). *(NPSMP Goals/Objectives/Strategies B.3.k.)*
b) Involve appropriate agencies and organizations. *(NPSMP Goals/Objectives/Strategies C.2.)*
c) Work with agencies for the protection and restoration of floodways and to increase riverine habitat on the Missouri, Mississippi and other major rivers. *(NPSMP Goals/Objectives/Strategies C.2.b.)*
d) Assure that fish and wildlife habitat development receives adequate consideration in project operation of large reservoirs.
e) Provide assistance or research support to help guide the application of resource management. *(NPSMP Goals/Objectives/Strategies A.2.a,b,c,d,e,f,g.)*

Objective I.4
Assist local governments with planning, development, enhancement and protection of urban natural resources. *(NPSMP Goals/Objectives/Strategies B.4.c,f,h,j,m.)*

Strategies:
a) Identify and pursue partnerships with local public and private entities. *(NPSMP Goals/Objectives/Strategies B.3.)*

b) Assess and support appropriate green space, greenways, wildlife corridors, trails and similar open space developments in urban areas.
c) Provide direct financial assistance, as appropriate, to local governments that make a commitment to improving the urban environment for fish, forests and wildlife.

Goal III
Increase opportunities for use of fish, forest and wildlife resources on other public land and water.

Objective III.1
Establish agreements and cooperative partnerships with agencies and organizations to facilitate management and use of fish, forest and wildlife resources on public and quasi-public land and water.

Strategies:
a) Work with neighboring states and the federal government to effectively manage inter-jurisdictional waters for healthy habitats, biota and compatible public use. *(NPSMP Goals/Objectives/Strategies B.3.)*
b) Coordinate recreation opportunities between the Department and other public and quasi-public land and water.
c) Explore feasibility of revising the Community Assistance Programs to more fully integrate forest, fish and wildlife resources and related opportunities.
d) Provide technical and financial assistance to encourage management and use of resources on other public lands. *(NPSMP Goals/Objectives/Strategies B.3.h.)*
e) Work with the owners and operators of large reservoirs and other affected interests to ensure that fish, wildlife and recreation are adequately considered in project operation.
f) Work with government entities and the private sector to promote use, enjoyment and appreciation of river and stream resources. *(NPSMP Goals/Objectives/Strategies B.3,4.g.)*

Private Land and Water
The potential to achieve positive resource management goals in concert with landowners is immense; however, capitalizing on this potential will require a wide array of services, incentives, educational programs and support. Moreover, development and presentation of private land management programs must be predicated on landowner needs and desires as well as sound resource management principles. It also is imperative that these efforts be well coordinated to achieve efficient delivery of services without reducing effectiveness.

Goal I
Protect, sustain, enhance, restore or create fish, forest and wildlife resources and communities on private land and water consistent with landowner needs and resource capabilities.

Objective I.1

Provide programs and services to assist landowners in meeting their fish, forest and wildlife management objectives in a manner that acknowledges and complements the wide range of reasons for which people own land.

Strategies:

a) Identify important regional resource needs that can only be met on private land; regionally target and promote resource management by private landowners. *(NPSMP Goals/Objectives/Strategies A.h.)*
b) Enhance our understanding of landowner objectives; focus direct technical assistance on those landowners who demonstrate commitment to long-term resource management; offer services and recommendations commensurate with the landowner's ability to implement them. *(NPSMP Goals/Objectives/Strategies B.4.h.)*
c) Educate landowners regarding inter-relationships of plant and animal communities and land use; develop a publication dedicated to landowners and related issues. *(NPSMP Goals/Objectives/Strategies B.4.g,h.)*
d) Evaluate and modify Department programs that involve professional guidance, technical assistance, and financial incentives to private landowners to ensure long-term effectiveness; develop and/or promote incentives to private landowners to encourage sustainable resource management. *(NPSMP Goals/Objectives/ Strategies B.h.)*
e) Develop in-house software containing all landowner incentive programs to keep field staff up-to-date.
f) Apply a multi-disciplinary approach to coordination of private land management services, and cross-train appropriate Department staff in all available private land management services, programs and incentives.
g) Work to improve land use practices; protect and restore riparian corridors, instream habitat, and promote water quality; design suitable programs and incentives. *(NPSMP Goals/Objectives/Strategies B., C.2.b.)*
h) Develop an expanded nuisance wildlife/damage control program.

Objective I.2

Identify and pursue land and resource management partnerships with private conservation organizations, land trusts, businesses and other non-governmental organizations.

Strategies:

a) Explore development of cost-share programs with private organizations, industry and other entities to promote fish, forest and wildlife enhancement. *(NPSMP Goals/Objectives/Strategies B.3.h.)*
b) Seek assistance from conservation organizations and corporations as co-sponsors for major grant proposals. *(NPSMP Goals/Objectives/Strategies B.3.)*

Objective I.3

Encourage and support local, state and federal initiatives that complement or promote fish, forest and wildlife management opportunities on private land and water.

Strategies:

a) Work to maintain or improve conservation provisions in the 1995 Farm Bill (e.g., CRP, WRP, SIP, etc.).
b) Offer clearinghouse functions, technical assistance or information for the various financial incentives available for fish forest and wildlife management on private land and water. *(NPSMP Goals/Objectives/Strategies B.4.h.)*
c) Explore development of cost-share programs with other state, federal, industry and local community entities to promote fish, forest and wildlife enhancement. *(NPSMP Goals/Objectives/Strategies B.3.h.)*
d) Seek common ground with local, state and federal agencies and work through their delivery systems to accomplish compatible resource management goals; ensure appropriate level of Department recognition. *(NPSMP Goals/Objectives/Strategies B.3.k., C.2.c.)*

Goal III

Improve protection and management of fish, forest and wildlife resources within the urban environment.

Objective III.1

Assist and support municipal resource managers in managing urban natural resources.

Strategies:

a) Work with providers of fish, forest and wildlife management programs, products and services for urban residents to ensure that their activities are compatible with and contribute to the protection and improvement of urban fish, forest and wildlife resources. *(NPSMP Goals/Objectives/Strategies C.2.c,k.)*
b) Assist in managing wildlife populations in urban areas.

Objective III.2

Develop programs, products and services that help urban landowners use, manage and improve the fish, forest and wildlife resources on their property, and in their neighborhoods and communities.

Strategies:

a) Provide technical assistance and advice to help urban residents deal with problem wildlife, forest insects and diseases and related problems.
b) Expand conservation related, outdoor recreational opportunities for urban residents. *(NPSMP Goals/Objectives/Strategies B.4.g.)*
c) Assist with preserving greenspace in rapidly developing areas by offering advice and assistance to related urban interest groups. *(NPSMP Goals/Objectives/Strategies B.4.h.)*

d) Provide homesite management programs, materials, and assistance that encourages naturescaping and backyard wildlife, and discourages use of chemicals and urban runoff. *(NPSMP Goals/Objectives/Strategies B.4.c,f,g,h.)*
e) Provide seminars and workshops for urban residents about fish, forest and wildlife topics and activities; expand the use of mass media in urban areas. *(NPSMP Goals/Objectives/Strategies B.4.g.)*

Education and Interpretation
Citizens must understand the importance and relationship of fish, forests and wildlife to their overall quality of life and economic well being if they are to embrace conservation. Many Department activities directly affect the resources under our auspices; however, without a Department/public partnership, achieving our constitutional mandate is impossible. Educating children and adults, about all aspects of conservation, may be the single most important task we do as an agency.

Goal I
Increase knowledge and understanding among Missourians of fish, forest and wildlife resources, natural communities and ecosystems, and the relationship of people to the natural resources.

Objective I.2
Increase emphasis and teaching of conservation principles as part of public, private and parochial school curricula. *(NPSMP Goals/Objectives/Strategies B.4.g.)*

Strategies:
a) Increase the use of conservation curriculum materials in schools, and employ direct delivery of certain conservation programs.
b) Promote and increase the incorporation of conservation in key skills and core competencies.

Objective I.3
Teach Missourians the social, cultural and biological relationships that exist between people and fish, forest and wildlife resources. *(NPSMP Goals/Objectives/Strategies B.4.)*

Strategies:
a) Emphasize conservation as the foundation of sustainable use.
b) Emphasize relationships between natural systems and human population, urban sprawl and development.
c) Develop and pursue activities that enhance the knowledge and understanding of natural resources held by urbanites, inner-city citizens and groups of differing cultural backgrounds.
d) Develop materials and programs that target the important impacts of various agricultural practices of various agricultural practices on fish, forest and wildlife resources.
e) Emphasize the benefits of healthy stream and aquatic resources as part of new and existing materials and programs.

NATURAL RESOURCES CONSERVATION SERVICE

Strategic Plan
(Excerpts)

Soil and water resources are inextricably linked. Water resource management is built on the foundation of effective soil conservation and management. The reduced erosion and runoff from cropland that will be achieved by hitting the 2002 targets for soil resources will make a substantial contribution to reaching our goals for water resources. Good soil conservation alone, however, will not ensure that adequate supplies of clean water are available to support people, communities, agriculture, and the environment.

The quantity and quality of our water supplies are largely determined by climate and the way we manage our land. Careful management of watersheds--the land that captures, stores, and supplies water to streams, lakes, rivers, reservoirs, and aquifers--is essential to ensuring sufficient supplies of high quality water to sustain our economy and the environment. Careful assessment of seasonally variable supplies and management of the way we use water resources to irrigate crops or sustain communities is also a critical component of effective watershed management.

Outcome

Water supplies in sufficient quality and quantity to sustain people, communities, wildlife, agricultural production and aquatic ecosystems.

2002 Targets (national)

- Beginning in the year 2002, water supply and water quality goals set by local communities achieved in 100 new watersheds each year.

- Potential for delivery of sediment, nutrients, pesticides, or salts from agricultural land to water bodies reduced by 25 percent from 1992 levels.

- Efficiency of irrigation water utilization improved by 3 percent from 1990 levels.

  Significant actions

  1. Accelerate training and build technical capacity of field staff and partners to emphasize water quality and water conservation in ongoing conservation planning for landowners and communities. *(NPSMP Goals/Objectives/Strategies B.4.i.)*
  2. Undertake national prevention initiatives to address five critical natural resource concerns with high potential for water quality or supply impairment:
     - ephemeral gully erosion
     - streambank and streambed erosion
     - irrigation water use and management
     - management and use of manures
     - erosion and runoff from developed or construction sites *(NPSMP Goals/Objectives/Strategies B.)*

3. Use the Conservation Reserve Program to achieve widespread use of riparian buffers, filter strips, grassed waterways and other vegetative buffer strips. *(NPSMP Goals/Objectives/Strategies B.3.f.)*
4. Enhance the agency's capability to evaluate and predict the effects of land use and management on water quality and water supply. *(NPSMP Goals/Objectives/Strategies A.2.)*

Strategic approach

Work with our partners to complete a comprehensive water resource needs assessment

Significant actions

1. Work with conservation districts through the locally led conservation initiative to compile water resource conservation needs assessments. *(NPSMP Goals/Objectives/Strategies A.1.)*
2. Work with EPA, USGS, NOAA, state conservation agencies, state water quality agencies, and other governmental and non-governmental partners to complete a scientifically based national inventory of the quality and quantity of groundwater and surface waters. *(NPSMP Goals/Objectives/Strategies A.)*

Strategic approach

Provide coordinated assistance to priority watersheds. *(NPSMP Goals/Objectives/Strategies B.)*

Significant actions

1. Complete conservation needs assessments through locally led conservation initiatives to identify watersheds with (a) urgent water supply or water quality problems, and (b) high-value water resources that require enhanced conservation assistance to prevent impairment. *(NPSMP Goals/Objectives/Strategies A.1.)*
2. Concentrate assistance through 1996 Act programs to provide enhanced assistance in priority watersheds to improve or prevent degradation of water supplies or water quality. *(NPSMP Goals/Objectives/Strategies B.b.)*
3. Leverage NRCS technical and financial assistance with that of local groups, agencies, and organizations in order to secure the full measure of resources needed to implement watershed solutions. *(NPSMP Goals/Objectives/Strategies B.3.k.)*
4. Develop multi-state specialized water resource assessment and planning teams to assist communities and watersheds in improving or protecting their water resources. *(NPSMP Goals/Objectives/Strategies B.3.c.)*
5. Develop watershed assessment and modeling tools for field application by water resource teams to guide watershed planning. *(NPSMP Goals/Objectives/Strategies A.2.o.)*

Strategic Issue 5 (North Central/Midwest Region)
Pesticide, Nutrient, and Manure Management

There are 129 million acres of cropland in the Region (34 percent of the national total). This is 44 percent of the total land within the Region. It is estimated that over half of the cropland needs some type of conservation treatment to adequately protect resources. The Region produces two-thirds of the nation's corn and soybeans. Commercial fertilizer, herbicides, and insecticides are used to increase production of these commodities. They are also widely used in rural and urban communities for turfgrass and horticultural applications.

There are also significant livestock and poultry numbers in the Region; including 16 million beef cattle, 5.7 million dairy cattle, 37 million hogs, 215 million chickens, and 96 million turkeys. These livestock generate 300 million tons of manure annually. The manure that is spread on farmland contains an estimated 780,000 tons of nitrogen and 580,000 tons of phosphorous. Because of economic factors, livestock and poultry production facilities are increasing in size and becoming more concentrated which results in greater threats to natural resource health.

Runoff and infiltration from rainfall, snowmelt, and irrigation water carry nutrients, organics, pesticides, and pathogens. This impacts surface and ground water quality as well as aquatic habitats. Recent studies have indicated that much of the region's soils have high phosphate levels, which may be an indicator of lands receiving too much manure or commercial fertilizer.

Goals

- Provide science-based information to customers in order to accelerate understanding and adoption of acceptable practices associated with pesticide, nutrient, and manure management

- Implement watershed-based nutrient and pest management plans

- Provide additional technical support for direct assistance to develop and implement watershed-based water quality plans for land managers

Desired Results
Nutrients, pesticides and manure are applied at rates that maximize production while minimizing damages to the region's surface and ground water. Highest and best use for all water in the region is achieved while maintaining economic viability and resource sustainability.

Water Quality and Quantity (Missouri Goals)
From lakes and streams to groundwater, Missouri's water quality, and quantity is fundamentally important to the health and economic prosperity of its citizens.

Sediment has degraded the quality of streams and reduced the storage capacity of lakes and reservoirs. Sedimentation is particularly troublesome in areas with extensive rowcrop production, where streams have been channelized, and in urban areas with rapid development.

Nitrogen and phosphorus are plant nutrients that have caused excessive growth of algae and bacteria in Missouri lakes and streams. The primary sources of these plant nutrients are excessive fertilizer application to cropland, poor animal waste management practices, and urban runoff.

Pesticide runoff has become a problem in a number of communities in north Missouri. Groundwater is naturally saline in much of north Missouri so residents must depend on surface reservoirs for drinking water. When rowcrops are extensively grown in the watersheds that supply their reservoirs, the pesticides used to produce these crops have been found in drinking water supplies. There has been recent concern over concentrations of atrazine in a number of these reservoirs that exceed the maximum levels established by the U.S. EPA.

- In 1994, 49 of Missouri's 102 surface water supplies had pesticide detects and 10 exceeded the maximum contaminant level (MCL) for atrazine.

- Animal waste management is a statewide concern. The Ozarks Region has received the most attention due to high quality streams and lakes in the region. Increased poultry and confined hog operations are emerging statewide issues. Recently, several significant animal waste spills from large corporate hog farms have occurred.

- Groundwater is the primary source of drinking water for many Missouri communities. While groundwater quantity is abundant throughout most of south Missouri, quality has been degraded in some areas by runoff of contaminants into sinkholes, losing streams, and abandoned wells.

  Strategies
  1. Accelerate the adoption of practices that reduce the sediment, pesticides, and nutrient delivery to Missouri's surface and groundwater *(NPSMP Goals/Objectives/Strategies B.1,2.f.)*
  2. Provide increased assistance to communities that have identified problems with their drinking water quality and supply. *(NPSMP Goals/Objectives/Strategies B.4.c,h.)*
  3. Expand irrigation water management methods and technology throughout the "Bootheel" of southeast Missouri through accelerated technical assistance. *(NPSMP Goals/Objectives/Strategies B.4.h.)*
  4. Assist the conservation partnership in efforts to educate Missouri residents about the critical nature of water quality and quantity.*(NPSMP Goals/Objectives/Strategies B.4.g.)*
  5. Develop new technology and practice application for land use management on a watershed basis.
  6. Form a unified coalition to address Missouri's water resources. *(NPSMP Goals/Objectives/Strategies C.2.)*
  7. Expand the Special Area Land Treatment (SALT) Program into agricultural nonpoint source pollution control. *(NPSMP Goals/Objectives/Strategies B.3.)*

     Expectations
     - An enlightened citizenry who are educated and outspoken in the wise use of Missouri's water resources

- ♦ Conservation practices and methods are adopted by land users that are economical, yet have a positive scientific-based but economical impact on water
- ♦ Land use planning based on sound ecological and watershed principles
- ♦ Conservation partners working together to maximize on each other's programs and actions to ensure water quality and quantity for Missouri residents

MARK TWAIN NATIONAL FOREST

Strategic Plan
(Excerpts)

Chapter IV
Forest Management Direction

Forest Management Goals (excerpts)

Wildlife/Fisheries Management Goals

Qualify, quantify and provide habitat for indicator species.

Manage habitat found on the Mark Twain National Forest to at least maintain viable populations of all existing native and desired non-native vertebrates.

Provide a habitat management program that responds to the demand for both consumptive and nonconsumptive fish and wildlife use.

Provide for wildlife species requiring specialized habitat including those recognized by both Federal and State authorities as being threatened, endangered, rare or sensitive.

Soil, Water and Air Management Goals

Identify a program that ensures the maintenance of soil productivity and the achievement of water and air quality objectives.

Objectives

Water and Soil Resource Management

Operations

The Forest Service, its permittees, and contractors, shall comply with or exceed all requirements of the State Water Quality Plan.

Management practices will be designed to minimize nonpoint pollution. *(NPSMP Goals/Objectives/Strategies B.)*

Maintenance of water quality will be achieved by the application of best management practices as defined by Forest Plan standards and guidelines. *(NPSMP Goals/Objectives/Strategies B.)*

Minimize soil compaction by curtailing the use of heavy equipment during extended wet periods on soils highly subject to compaction.

Soil scarification or ripping practices may be used in meeting restoration objectives when soil compaction limits effective revegetation or has resulted in reduced soil productivity.

The following filter strip widths will be used. Exceptions for smaller filter strips may be made if T-value standards listed under Soil Production 2500 are met and other resource objectives are not jeopardized.

Include in the filter strip only the area to the break of the slope when the slope adjacent to the watercourse is shorter than the filter strip width shown below. Disregard benches less than 50 feet in width within the filter strip.

The minimum filter strip (the initial 100 feet of larger filter strips) complement buffer zones recognized by standards and guidelines for specialized habitats.

Width of Filter Strip by Percent Slope for Each Side of Stream to be Protected

	Percent Slope						
	0	10	20	30	40	50	60
	Filter Strip Width, Feet						
Perennial:	100	100	130	170	210	250	290
Intermittent:	100	100	130	170	210	250	290

Fertilizer applications shall not exceed the soil's nutrient retention capacity. (Fertilizer applications are not applicable to Management Prescriptions 5.1 or 9.1). *(NPSMP Goals/Objectives/Strategies B.)*

Riparian area management will emphasize their protection and improvement as specialized wildlife habitat and the enhancement of their visual quality to complement recreational use. Reference Forest-wide Standards and Guidelines 2300 – Rivers and 2600 – Riparian Specialized Habitat.

Limit heavy equipment use in filter strips and stream sides to the dry season or when the ground is frozen. Reference Forest-wide Standards and Guidelines 2400 and 2600 for additional filter strip and riparian zone requirements.

Dredge and fill activities shall comply with Corps of Engineer permit requirements.

All activities of the Forest Service and its permittees shall comply with provisions of Executive Order 11988 (Floodplain Management) and 11990 (Wetland Protection). The Mark Twain National Forest Terrestrial Ecological Classification Inventory identifies floodplain ELT's.

The following additional guidelines shall be applied to all facilities, structures, and other major investments in floodplains:

Floodplain location shall be avoided to the extent possible and practical. *(NPSMP Goals/Objectives/Strategies B.)*

Where floodplain avoidance is impossible or impractical, investment costs will be kept to the minimum necessary to accomplish the basic objectives so that financial losses and repair or replacement costs in event of flooding are minimized.

Developed recreation areas on the floodplain will be designed, constructed, operated, maintained, and repaired in the following manner:

Floodplains will be developed only in response to identified public recreation or resource protection needs.

Recreational development will be the minimum which satisfies the ROS classification and development scale and/or resource protection needs.

The most frequently flooded portion of the floodplain will be avoided to the extent practical.

Floodplain facilities will be inexpensive to replace or sufficient to physically resist or otherwise avoid damage by floodwaters, whichever offers the best resource protection at the least cost in the long run.

The Mark Twain National Forest Aquatic Ecological Classification inventory identifies wetlands (palustrine aquatic type associations).

Wetlands will have a minimum of a 100-foot wide peripheral zone within which any management prescription will be modified on a case-by-case basis to: (Not applicable to Management Prescription 5.1)

Maintain and improve wetland values. *(NPSMP Goals/Objectives/Strategies B.)*

Comply with the riparian area management standards and guidelines including those identified for wildlife species with specialized habitat (standards and guidelines 2600).

Comply with river corridor management (standards and guidelines 2300).

Comply with Executive Order 11990 for wetland management.

Protect the visual resource.

Protect and enhance natural plant and animal communities.

Soil Productivity

Maintain soil productivity and enhance through natural processes.

Control accelerated erosion. *(NPSMP Goals/Objectives/Strategies B.)*

The Mark Twain National Forest Terrestrial Ecological Classification System Report and its interpretations will be used to evaluate soil management impacts relative to ecological landtypes when designing cultural practices.

All practices of the Forest Service, its permittees and cooperators shall use the following criteria in assessing adequacy of treatments in maintaining soil productivity.

> No vegetative manipulation or utilization practices shall cause average annual soil loss to exceed Soil Conservation Service T-values. See ECS reports for exact T-value interpretations by ELT and soil series.
>
> (A table of guidelines for T-values is supposed to be inserted here but was not reproduced. Contact Larry Furniss, Mark Twain National Forest, for additional information or a copy of the table.)
>
> Vegetative manipulation and utilization practices which are applied at intervals shall not create conditions likely to cause soil loss during the first 12 months after disturbance in excess of the following on all soils except Gasconade and Ramsey soil series and the Granite Glades.
>
> > 1.0 times the Soil Conservation Service T-values on sites with a low or medium natural soil improvement potential.
> >
> > 1.5 times the Soil Conservation Service T-value on sites with a high natural soil improvement potential.
>
> On the Ramsey and Gasconade soil series and Granite Glades no vegetative manipulation or utilization practices shall create conditions likely to cause average annual on-site soil loss in excess of formation rate over the life of the practice.
>
> Until the results of the cooperative research study on Gasconade soils can be incorporated in Forest Plan standards and guidelines, current practices will be applied.

Restoration objectives of highly disturbed areas, such as borrow pits, mined areas, and drill sites, will be determined on a case-by-case basis considering opportunity, economics, surrounding landscape, area objectives, and other pertinent factors.

Stream channelization on National Forest System lands by the Forest Service and others will only be done in emergency situations and only in the event that stream course stabilization is not practical. *(NPSMP Goals/Objectives/Strategies B.)*

Sedimentation of waterways shall be prevented or minimized where earth moving jobs such as road construction, drill site benching, or similar activity unavoidably bares sizeable areas of soil for extended periods of time. *(NPSMP Goals/Objectives/Strategies B.)*

IV.

NONPOINT SOURCE MANAGEMENT PRIORITIZATION

PRIORITY POLLUTANT CATEGORIES

PRIORITY WATERS

WATERSHED PRIORITIZATION

NONPOINT SOURCE FOCUS AREAS

NONPOINT SOURCE MANAGEMENT PRIORITIZATION

EPA, beginning with their 1987 guidance to states for preparation of the 1988 state water quality assessments [305(b) reports] has outlined NPS pollution categories and subcategories the states are required to address. Table 1, which follows, lists the current categorization according to the USEPA Grant Reporting and Tracking System. As required, Missouri's NPSMP designates the categories and waterbodies of highest priority in the state. The individual category narratives (Appendix E) characterize the impact of that NPS category, denote any regulatory authorities existing and suggest recommended changes, if needed.

PRIORITY POLLUTANT CATEGORIES

1. Agricultural Nonpoint Sources

The agriculture industry is one of the state's largest industries. Land in farms makes up 28.5 million acres or 65 percent of the state with about 16 million acres of that either harvested or pastured land (Bureau of the Census, 1994). Given the relative scale of the activity, the potential for NPS pollution places agricultural operations at the top of the priority ranking, as determined by category of pollutant. Within that category, sediment, fertilizer, pesticides and animal waste are the primary pollutants.

Implementation of watershed projects addressing agricultural pollutants generally will receive preference in receipt of financial and technical assistance. Projects that address regional issues and extend across watershed boundaries will also be used to provide information and education sessions, demonstrations of pollutant management technologies and technical assistance.

Sediment and soil erosion are the primary sources of NPS pollutants in Missouri streams. The state has an agricultural soil erosion prevention program to address this pollutant. It is successfully funded by one-half the proceeds of a 1/10 of one percent sales tax. Local project sponsors are encouraged to couple their soil erosion practices and monies with other NPS practices and dollars to achieve comprehensive treatment and improved water quality.

2. Urban Nonpoint Sources

Urban nonpoint sources are a major concern as urban areas continue to expand at increasing rates. Urban nonpoint sources have had a significant negative influence on water quality. Sediment is the primary contaminant, and severe water quality impacts also stem from the modification of storm flow regimes and the loss of aquatic habitat.

Table 1

NPS Categories & Subcategories

Agriculture	
Non-irrigated Crop Production	Stowage and Land Disposal
Irrigated Crop Production	Sludge
Stream Bank Erosion	Wastewater
Range Land	Landfills
Feedlots - All Types	Industrial Land Treatment
Aquaculture	On-site Wastewater Systems
Animal Holding/Management Areas	Hazardous Waste
Other	Other
Urban Runoff	Hydrologic Modification
Residential	Channelization
Industrial	Dredging
Commercial	Dam Construction
Open Space	Flow Regulation/Modification
Other	Bridge Construction
Silviculture	Riparian Area Degradation
Harvest, Reforestation, Residue Mgmt.	Streambank
Forest Management	Modification/Destabilization
Road Construction/Maintenance	Other
Other	Other
Construction	Atmospheric Deposition
Highways, Roads, Bridges	Waste Storage/Storage Tank Leaks
Land Development	Highway Maintenance/Runoff
Other	Spills
Resource Extraction	In-place Contaminants
Surface Mining	Natural
Subsurface Mining	Septic Tanks
Placer Mining	Recreation
Dredge Mining	Other
Petroleum Activities	Source Unknown
Mill Tailings	
Mine Tailings	
Sand/Gravel Mining	
Other	

Source: USEPA Grant Reporting and Tracking System, 1997.

Good quality proposals addressing urban NPS pollution will be considered a second priority for receipt of 319 grants provided the focus is on alternative or innovative stormwater management in settings not required to have a NPDES permit. Practices in new or developing areas or retrofits within existing areas which retain or slow runoff are preferred, for example innovative uses of swales, "rain gardens," wetlands or pervious surfaces. Enhancement of riparian corridors will also be eligible. Urban proposals should have a strong demonstration and technology transfer component and/or restoration component.

3. Acid Mine Drainage from Abandoned Coal Mined Lands
These sites are primarily historical in origin. The presently operating mines are regulated to the point that contaminants are controlled through permits. Abandoned mined lands contribute localized chronic impairments and episodic impacts to Missouri's water bodies. The primary contaminants are acidity and sulfate. The scale of many sites is too large to be addressed through NPS funding, although smaller treatable sites may be considered. Additional sources would be required to address the universe of these problem areas.

PRIORITY WATERS

1. Waters on the 303(d) List
Section 303(d) of the 1972 federal Water Pollution Control Act (as amended) requires states to develop a list of waters that do not meet water quality standards and thus require additional pollution controls. These waters are referred to as "water quality limited" (WQL) and must be periodically identified by the state agency designated with this responsibility. In Missouri, DNR is the designated state agency. This list (Appendix F), the development of which includes public participation, must be approved by EPA every two years.

The 303(d) process also requires a strategy for bringing those waterbodies back into compliance, that is, improving water quality to the point where recognized beneficial uses of the water are fully supported, within a reasonable period of time. The primary strategy is the development of Total Maximum Daily Loads (TMDLs). The development of a TMDL addresses pollution problems by systematically identifying the water contaminants causing the water quality impairment, linking them to watershed characteristics and management practices, establishing objectives for water quality improvement, and identifying and implementing new or altered management measures designed to achieve those objectives.

Waters on the 303(d) list, which are impacted by nonpoint sources, are the highest priority for implementation of comprehensive watershed projects and restoration activities. These projects are expected to improve water quality, particularly those with action plans that include all the components necessary for approval as voluntary TMDLs. (See the "TMDLs and the 303(d) List" section for action plan requirements.)

2. Prevention of Degradation of High Quality Waters
Waters designated "Outstanding National or State Resource Waters" in need of protection from degradation will follow as second priority. The same will be said for cool or cold water fisheries, or other high quality waters for which strong antidegradation requirements apply. Listings for Outstanding National Resource Waters (10 CSR 20-7, Table D), Outstanding State

Resource Waters (10 CSR 20-7, Table E), Streams Designated for Cold-Water Sport Fishery (10 CSR 20-7, Table C), and streams designated for cool water fishery in Stream Classifications and Use Designations (10 CSR 20-7, Table H) may be found in Appendix G.

3. Waters Almost Meeting Criteria for Inclusion on the 303(d) List

Third priority water bodies will be those waters that are close to meeting the criteria for being placed on the 303(d) list as impacted by NPS pollutants, but have not yet attained that status. For example this would include public drinking water reservoirs approaching an exceedence of the 3 ug/l atrazine limit. (See Appendix H.)

WATERSHED PRIORITIZATION

Missouri has historically used an NPS watershed ranking distinguished between ranking watersheds as to degree of problem and prioritizing them for treatment. The ranking process is a judgement as to the relative NPS pollution problem in the watershed, while the prioritizing takes into account not only the degree of NPS problem but economic, political, institutional and public participation constraints.

For the purposes of that ranking, Missouri recognized three types of NPS pollution problems, listed here in order of descending importance: human health, drinking water supply/non-health related; and protection of aquatic life.

As part of the Clean Water Action Plan in 1998, all states were required by the federal government to develop Unified Watershed Assessments, Restoration Priorities and Restoration Action Strategies. State, federal, tribal and local governments were asked to work with stakeholders and interested citizens to: (1) identify watersheds with the most critical water quality problems, and (2) work together to focus resources and implement effective strategies to solve these problems. A copy of Missouri's Unified Watershed Assessment (UWA) can be found on the Internet at {http://www.cares.missouri.edu/mowiap/} or may be obtained by contacting DNR or the Natural Resources Conservation Service in Missouri.

The framework for developing the UWA specified that states use an 8-digit hydrological classification unit. Missouri's 66 8-digit hydrological units (HU) were evaluated to determine those most in need of restoration. These were designated as Category I watersheds. The 56 Category I watersheds were evaluated using a numerical ranking system involving 21 criteria. These 21 criteria were selected because statewide data was available at the 8-digit level, and the information they represent is pertinent to the ranking. Watersheds were then ranked by their scores from high to low.

The Clean Water Action Plan provides that a significant part of any new funding requested by the president for fiscal year 1999 and beyond be targeted to restoration of those watersheds identified as not meeting clean water and other natural resource goals. The plan calls for states and tribes to develop Watershed Restoration Action Strategies for these watersheds, which could include, for example: priority and schedule for detailed assessments; review of clean water and other goals; development of a TMDL for pollutants exceeding state water quality standards; identification of sources; identification of natural resources that could be enhanced; schedule for

implementation; identification of needed monitoring and evaluation; identification of lead agency; funding plans; and process for public involvement.

The Missouri Unified Watershed Steering Committee members provided their top five watersheds for restoration in fiscal years 1999 and 2000. These individual listings factored in the final watershed assessment ranking along with: program information regarding projects scheduled for planning and/or funding through Section 319 of the Clean Water Act, proposed EQIP priority areas, locally led watershed planning initiatives, recent concerns related to public drinking water, agency priorities and other known opportunities for technical and/or financial success. Priority watersheds for 1999 are:

James River Basin
Spring River Basin
South Grand River Basin
Sac River Basin
Lower Salt River Basin

For 2000, the priority watersheds are:

Maries Des Cygnes River Basin
Upper Osage River Basin
North Salt River Basin
Upper St. Francis Basin
Little Chariton River Basin

The use of the 8-digit HU level creates significant challenges to the use of the UWA as a prioritization tool. It is difficult and often impractical to develop locally led, well-designed watershed projects addressing the entire HU. Within any of the priority 8-digit watersheds, there are sub-watersheds that would not be considered a high priority if this evaluation had been conducted at an 11- or 14-digit level. For this reason, Missouri has elected to use the 303(d) list as the primary prioritization tool. To the extent practical, the UWA will be used as a second prioritization tool, with the recognition that projects addressing watersheds at smaller than the 8-digit level area appropriate. It is expected that the UWA will be refined in future years and may then be more appropriately used as a primary ranking tool.

NONPOINT SOURCE FOCUS AREAS

In order to be fully effective, a NPS management program must present a balanced, broad-ranging approach to pollution prevention. It must emphasize a watershed management approach and be well integrated with other important programs to protect and restore water quality. These include point source, groundwater, drinking water, clean lakes, wetlands protection, soil conservation, pesticide management and other natural resource and environmental management programs. The program must also include statewide or regional information and education efforts as well as demonstrations of innovative solutions to new or long-standing problems. States have been given the flexibility to design programs best suited for their needs.

Missouri's approach is one of voluntary pollutant prevention and control in implementing NPS projects. It will support community-based, locally led, watershed-defined water quality projects. In waters impaired due to NPS pollution, it will support formal but voluntary TMDL development for the highest priority waters and work with local communities to assist their leadership in implementing comprehensive watershed management. In unimpaired waters, it will support community-based, locally led, watershed-defined water quality projects pursuant to items 2. and 3. of the section on Priority Waters.

The federal Clean Water Action Plan directed states to focus substantial effort on the restoration of impaired waters. Incremental grant funds pursuant to Section 319 of the Clean Water Act are to be provided to help states, territories and their partners implement Watershed Restoration Action Strategies for watersheds identified in Unified Watershed Assessments. Within the existing grant framework, incremental funds under Section 319 are to be focused upon implementing Watershed Restoration Action Strategies in areas identified by Missouri's Unified Watershed Assessments as being in need of restoration. These areas, referred to as "Category I" watersheds, are defined as those watersheds that do not now meet, or face imminent threat of not meeting, clean water and other natural resource goals. For the use of incremental 319 grant funding in FY2000 and in the future, Missouri will emphasize restoration of the highest priority watersheds identified in the UWA as needing to be addressed in fiscal years 1999 and 2000 and as revised in future years.

V.

NONPOINT SOURCE ASSESSMENT

NONPOINT SOURCE ASSESSMENT

Water quality assessment and monitoring is the foundation of an effective NPS management program. Missouri has a variety of water quality monitoring activities, as well as a strategy for current and future NPS assessment.

OVERVIEW OF MONITORING ACTIVITIES

Fixed Station Monitoring Network

Eighty-three of the 95 stations in Missouri's fixed station chemical monitoring network are sites uninfluenced by point source discharges, making these sites good indicators of water quality influenced by extensive regional nonpoint sources. These sites cover all major physiographic regions of the state and provide valuable information on typical water quality during stormwater runoff as well as the subsurface flow contributions of NPS pollutants during baseflow conditions. This network includes monitoring of six large springs which provide information of the quality of storm waters entering the groundwater system. In addition to the state ambient monitoring network, the state routinely reviews similar data generated by other agencies. In total, about 117 sites provide data on NPS pollutants from such extensive land uses as cropland, mixed cropland and pasture, mixed forest and pasture. (See Appendix K, Proposed Water Quality Monitoring Plan for Missouri, 05/99.)

Over 60 Missouri reservoirs are being sampled for nutrients, chlorophyll and suspended solids and secchi depth by the University of Missouri under contract to DNR and some of these lakes receive more intensive monitoring assisted by volunteers. Volunteers are sending in data for over 840 stream sites.

Fixed Station Fish Tissue Network

With the passing of the use of chlorinated hydrocarbon insecticides such as dieldrin, chlordane, DDT, heptachlor, mirex and lindane, there is less need in the Midwest for an aggressive fish tissue monitoring effort. New pesticides are more water-soluble, degrade much more rapidly and do not tend to concentrate in body tissue. Heavily used pesticides such as atrazine tend to be metabolized or passed from the body of fish and other aquatic animals at about the same rate as their uptake from the environment. However, fish consumption advisories for chlordane, dieldrin and PCBs remain in effect for some areas of the state. Levels of mercury in fish are increasing. Missouri DNR and USEPA jointly maintain a fish tissue (whole fish) monitoring network of fifteen stations with half of these sites sampled each year. Samples are analyzed for several chlorinated hydrocarbon insecticides, PCBs, lead, mercury and cadmium.

The Missouri Department of Conservation (MDC) also collects and analyzes many fish tissue (fillets) samples per year. They do not maintain a fixed network but they do analyze for a similar list of contaminants as the DNR/EPA network. Fish tissue monitoring in Missouri has documented declines in chlorinated hydrocarbon insecticides in fish over time, but increasing levels of mercury in fish.

Mercury Advisory
In 2001 the Missouri Department of Health and Senior Services issued a statewide advisory against consumption of Largemouth Bass greater than 12” in length by pregnant women, women who may become pregnant and children 12 years of age and younger. Review of the state’s fish tissue data base showed 40 streams and lakes with average Largemouth Bass mercury tissue levels above those deemed to be safe. These waters are proposed for the state 303(d) impaired waters list and a multi-agency committee is looking at development and funding of a larger mercury monitoring strategy for the state.

Special Studies
An extremely large number of monitoring activities fall into this category including: monitoring of watershed projects sponsored by Section 319, by the NRCS, by the DNR Soil and Water Conservation Program, by the U.S. Geological Survey NAWQA program, the USDA Management Systems Evaluation and Analysis (MSEA) projects, water quality or hydrologic studies by the U.S. Geological Survey, special water pollution investigations undertaken by state agencies such as the DNR or the MDC. Many waterbodies in the state impaired or believed to be impaired by NPS pollution will be the subject of additional study under section 303(d) of the CWA.

Aquatic Biological Community Data
Over the years a relatively large volume of data has been gathered on fish and aquatic invertebrate communities in Missouri streams. The major sources of data include William Pflieger’s *Fishes of Missouri*, which summarized fish distribution in the state from records from 1853 through 1969, considerable unpublished data on fish collections made by the MDC since 1969, and a large number of reports by both the DNR and the MDC on collections of aquatic macroinvertebrates. Most recently two projects, the USEPA REMAP project and the development of water quality criteria for aquatic invertebrates by the DNR have added to the information base for fishes and invertebrates.

DNR retains the capability to assess about 55 sites twice annually using quantitative macroinvertebrate sampling and application of biological criteria. The MDC state-wide fish community monitoring program was terminated due to inadequate funding and loss of key personnel. Ecological monitoring of fish communities is a key element in a nonpoint source management program and the re-establishment of fish monitoring activities need to be given high priority.

Volunteer Water Quality Monitoring Program
Between 1993 and November 21, 2003, 3027 individuals attended at least one training workshop offered by the Missouri Volunteer Water Quality Monitoring Program. Levels of training include Introductory, and Levels 1 through 4. Volunteers from 1700 sites around the state have submitted water quality data. 12,434 sets of data have been processed from those monitoring sites, including 2644 sets of visual survey data, 6845 sets of chemical data and 2945 sets of biological monitoring information. As more citizens participate in the quality assurance/quality control (QA/QC) portion of the program (Level 2 and up), the value of volunteer-generated data will increase. Of the 383 individuals who have participated in the QA/QC levels of the program, 71of those

individuals have been certified as Level 3 monitors, which until this year represented the highest level of QA/QC the program offered. In 2003, the first Level 4 volunteers were trained as part of a pilot program. Four Level 3 monitors attended training on chain-of-custody and sample collection and preservation according to standard department operating procedures in order to participate in Level 4 monitoring. Samples are being collected from Hinkson Creek (a 303(d)-listed stream) for analysis by the State Environmental Laboratory. State lab analysis differentiates Level 4 data from that collected by other volunteers. Data collected in such a manner could be used for TMDL studies, in the evaluation of permits, or for long-term studies on resource use. The pilot Level 4 study will be evaluated prior to expanding its availability. Volunteer data supplements the information used by state and local decision-makers to determine current stream conditions and helps them identify potential problems or trends in water quality.
[Numbers derived from 11/21/03 Stream Team Access databases (including Dick Duchrow's Sitemaster table]

NONPOINT SOURCE ASSESSMENT STRATEGY

In the past, assessment of the impacts of nonpoint sources were required for completion of the state's 305(b) report, for writing statewide section 208 plans and for developing section 319 plans, and those assessments have relied on these strategies:

A. Discrete, relatively localized nonpoint sources such as drainage from abandoned mine lands could be accurately characterized by water chemistry studies. Almost all of these areas, both coal and lead-zinc mined lands have been accurately assessed as to NPS pollution impact on receiving waters by a combination of intensive studies. These studies have characterized the degree and extent of problems in the short term and for some sites, fixed station water quality monitoring which has tracked longer term time trends and improved our knowledge of the relationship of the problem to flow regimes and other variables.

B. Frequency and concentrations of synthetic organic chemicals such as pesticides have been well documented by chemical monitoring of waterbodies. The biological impact of these chemicals on aquatic fauna and humans has not been fully researched.

C. Large scale, diffuse nonpoint sources such as row crop agriculture, animal production and pasture have been much more difficult to quantify, not only because of their diffuse nature, but because the pollutants of primary concern, sediments and nutrients, and the processes which deliver them to waterbodies are natural ones. Assessing the amount of NPS pollution from these sources by quantifying sediment and nutrient loads first requires we know the natural, or background, level of sediment and nutrients in these waters. We do not know these background levels. Another serious drawback to attempting to quantify NPS pollutant loads from these extensive land uses is the difficulty and expense of getting adequate water chemistry data.

In the past, Missouri has relied heavily on the fish distribution work of Pflieger, which has shown the loss or the substantial decline in the populations of certain fish species

across the agricultural northern third of Missouri and similar losses in the agricultural Bootheel of Missouri. In the less intensively farmed Ozark plateau, fish populations have suffered less, but the distribution of many species seems to be retreating from headwater streams. This data, combined with studies in the technical literature on the impacts of channelization and other physical disturbance to stream channels has been the foundation of our assessment that agricultural NPS pollution affects virtually all streams in the glaciated plains, Osage plains and Bootheel regions of Missouri. We will continue to track, with interest, the U.S. Geological Survey studies pertaining to heavy gravel loads in Ozark streams and their relationship to land use.

As the NPS program in Missouri has matured, our NPS assessment activities have become more focused. The three major areas of interest are:

A. Research into the relationships of nutrients, algae and suspended sediments in Midwestern reservoirs by Dr. Jack Jones, Univ. of Missouri

B. Research on stream biota and how they are affected by physical changes in the stream channel and riparian zone

C. Development of biological criteria for aquatic macro invertebrate communities and subsequent development of a statewide fixed station network of aquatic macro-invertebrate monitoring sites

Our hope is that over the next ten years the overall improvement of our understanding of the relationship of aquatic biota communities to such physical manifestations of extensive nonpoint sources such as eutrophication, sedimentation, channel morphometry changes and changes in the riparian zone will allow us to better discern NPS problems in specific watersheds and target future watershed projects more accurately.

REFERENCES

Pflieger, Wm. L., 1975, The Fishes of Missouri, Missouri Department of Conservation, Jefferson City, MO 65102.

Stream Team Access databases

VI.

TOTAL MAXIMUM DAILY LOADS (TMDL)
THE 303(d) LIST AND
VOLUNTARY WATER QUALITY MANAGEMENT PLANS

Section 303(d) of the 1972 federal Clean Water Act (as amended) requires states to develop a list of waters that do not meet water quality standards and thus require additional pollution controls. These waters are called "water quality limited" (WQL) and must be periodically identified in each state by the federal EPA or by the state agency designated this responsibility. In Missouri, DNR has this responsibility. WQL waters requiring additional pollution controls are identified in a document commonly referred to as the 303(d) list (Appendix F). This list, developed by DNR, is subject to public review and must be approved by EPA at least every two years. The 1998 303d list can be viewed at: http://www.dnr.mo.gov/wpscd/wpcp/tmdl/tmdl_list.pdf. [Note to reviewers: This statement and link will be updated to reference the 2002 303(d) List when complete information on the listed waters is received from EPA.]

A strategy for bringing a waterbody back into compliance with water quality standards – that is, for improving water quality to the point where recognized beneficial uses of the water are fully supported – is to conduct and implement the findings of a TMDL study. This study addresses pollution problems by systematically identifying the water contaminant causing the water quality impairment, linking it to watershed characteristics and management practices, establishing objectives for water quality improvement, and identifying and implementing new or altered management measures designed to achieve those objectives.

A full TMDL development process determines the pollutants or stressors causing water quality impairments, identifies maximum permissible loading capacities for the waterbody in question and, for each relevant pollutant, assigns load allocations to each of the different sources, point and nonpoint, in the watershed. The allocations are the Total Maximum Daily Loads allowed, although for most NPS contaminants, they are usually annual, rather than daily allowable loads.

Nonpoint source pollutants are substances of widespread origin that run off, wash off, or seep through the ground, eventually entering surface waters or groundwater. Nonpoint source pollution results from diffuse sources rather than from discharge at a specific location (such as the outfall pipe from a sewage treatment plant), and the greatest loads of NPS pollution often are associated with a few heavy storm events spread out unpredictably over the year.

These characteristics of nonpoint sources mean that seldom will NPS control programs use Total Maximum Daily Load allocations as a means to specify or measure pollutant reductions in agricultural or untreated urban stormwater runoff or other typical NPS situations. Consequently, the term TMDL may seem awkward when applied to these situations. However, quantifiable maximum pollution loads may still be set by larger geographic units (watersheds) and by longer time periods (seasons or years). Also, a TMDL program is understood to be a program of special, intensive, and focused strategies for reducing pollution and bringing 303(d) listed waters back into compliance with water quality standards. This is as appropriate a strategy for nonpoint sources as it is for point sources. More information on TMDL's can be viewed at the DNR website: http://www.dnr.mo.gov/wpscd/wpcp/wpc-tmdl.htm.

Water Quality Management Plans

A properly prepared, watershed scale, *voluntary* Water Quality Management Plan (WQMP) can function as part of a TMDL. To be acceptable as a nonpoint source TMDL implementation strategy, a water quality management plan must be a thorough, objective-driven, adequately funded, fully monitored, long-term, watershed enhancement approach with significant commitment demonstrated by local land owners and managers. The TMDL may also include repeating steps based on monitoring feedback. Most importantly, the goals and objectives of the WQMP must focus on achieving water quality standards at the earliest possible date. Watershed-scale plans to manage natural resources can take many forms in response to the local situation. Similarly, specific management practices and objectives will be selected to meet the local need.

DNR believes that the best solutions to water quality problems are those with broad and active local support and involvement. Citizens across Missouri are proceeding with watershed enhancement projects. However, in those areas with listed waters where an effective local commitment to water quality improvement is slow to form, DNR and other agencies will have to move ahead with the actions necessary to implement the law and protect water quality. If the agencies fail to do so in a timely manner, the requirements may be enforced by citizens through the courts, a likelihood well documented by citizen law suits in a number of states across the nation. The result could be watershed management plans developed and imposed with less local involvement and support than desired. The best way to avoid this unsatisfactory situation is for local citizens and government agencies to join in partnership to sufficiently address water quality problems before impaired waters are added to the 303(d) list or, alternatively, to remove waters from the 303(d) list as soon as possible.

Removing Waters from the 303(d) List

The waters on the 303(d) list have significant water quality problems that prevent one or more of their beneficial uses from being fully met. Federal and state laws require the protection of water quality and aquatic beneficial uses. Additionally, most Missourians believe our waters must be clean and healthy, not only for the sake of humans but also for the protection of other species, such as fish, which require use of water resources.

There are several conditions that allow a waterbody to be removed from the 303(d) list:

- The data or analysis used to list the water is shown to be inaccurate or inadequate (i.e., the water quality in question actually does meet standards after all).
- The water quality standard violated by the waterbody is changed so the waterbody no longer is in violation. This includes the possibility that local conditions may be officially recognized (e.g., allowing a higher temperature in a particular waterbody in recognition of “natural” conditions).
- Water quality improves to meet standards. *A voluntary WQMP implemented prior to the scheduled TMDL and which improves and sustains water quality at a level meeting standards would result in removal of the water body from the 303(d) list.*
- A fully quantified TMDL covering both point and nonpoint sources is set and implemented and water quality improves to meet standards.
- Other pollution control requirements (e.g., stemming from urban stormwater

management programs) are determined to be sufficiently stringent to qualify as a TMDL equivalent.

- *A WQMP is approved for implementation as an NPS TMDL, implemented, and water quality improves to meet standards*.

VII.

FUNDING

SOURCES OF FUNDING

Federal

Clean Water Act of 1987, Section 319: Congress appropriated the first section 319 grant funds in Fiscal Year 1990. Although the Clean Water Act (CWA) authorized $400 million nationwide for a four-year nonpoint source (NPS) program, that authorization has expired. Congress has, however, continued to appropriate funds. Recent appropriations have been approximately $100 million nationally. Pursuant to the Clean Water Action Plan, Congress appropriated an additional $100 million nationally for fiscal years 1999 and 2000. In fiscal year 2001, a total of $235 million was appropriated. In each of these three years, $100 million was designated as "incremental" funding and was directed for use on projects that result in restoration of priority watersheds identified in the Unified Watershed Assessment. Guidance for fiscal year 2002 indicates that that requirement may be further modified to allow expenditure of these funds only for the development of implementation of Total Maximum Daily Loads. For fiscal years 2001 and 2002, Missouri received just over $3 million in base funds and just over $2.3 million in incremental funding. Until Congress reauthorizes the Clean Water Act, or significantly changes trends in appropriation, the base-funding amount will remain a planning target.

The Act requires at least a 40 percent non-federal match for NPS grants.

Clean Water Act of 1987, Section 104(b): Section 104(b) grants may be used for regulatory or non-regulatory activities and require a nonfederal match of 5 percent. Availability is very erratic. This source will not be used in a planning target.

Clean Water Act Section 603 (c)(2), State Revolving Loan Funds: The CWA established a state revolving loan fund which may be used for water pollution control activities, including implementation of state NPS management programs. To be eligible, states must submit an "Intended Use Plan" and identify the types of NPS implementation activities that will be eligible. States have some flexibility in establishing policies such as interest rates and repayment periods not to exceed 20 years for administering their revolving funds.

Thus far the State Revolving Fund (SRF) program has provided low interest loans to producers for the construction of animal waste treatment facilities. The program continues to explore new and expanded uses of the fund for NPS projects. These uses may include such things as fencing to provide stream protection, construction of grassed waterways, diversions, filter strips, septic tank repair or replacement, brownfields redevelopment, etc. The proposed SFY 2004 Intended Use Plan designated $10,000,000 for NPS projects.

Clean Water Act Section 314, Clean Lakes Program: This federal grant program was established in 1972 to provide financial and technical assistance to States in restoring

publicly owned lakes. Program activities were directed to diagnose the condition of individual lakes and their watersheds, determine the extent and sources of pollution, develop lake restoration and protection plans, and implement these plans. The program was expanded to include statewide assessments of lake conditions. There have been no appropriations for the program since 1994 and states have been encouraged to use Section 319 funds to fund eligible activities that might have been funded in previous years under Section 314 (Appendix L). This source will not be used in a planning target.

Safe Drinking Water Act of 1996 (SDWA): The SDWA provides funding for a drinking water revolving fund for low interest loans to public water systems for capital improvements (planning, design and construction of water plants, tanks, lines, etc.) After the source water protection program established by the SDWA is implemented, the state may use up to ten percent of its annual allotment for source water protection activities.

Transportation Equity Act for the 21st Century (TEA-21) (1998): The TEA-21 authorizes over $200 billion to improve the nation's transportation infrastructure, enhance economic growth and protect the environment. TEA-21 creates new opportunities to improve air and water quality, restore wetlands and natural habitats, and rejuvenate urban areas through transportation redevelopment, increased transit, and sustainable alternatives to urban sprawl. Among other things, TEA-21 includes provisions that target the nation's leading cause of water pollution - NPS runoff.

In TEA-21, 10% of Surface Transportation Program (STP) funds ($3.3 billion over six years) are set-aside for transportation enhancements (TEs). A wide array of environmental and water quality improvement projects are eligible for TE funding, including pollution abatement and mitigation projects. TEA-21 also provides that up to 20% of the cost of a transportation facility reconstruction, rehabilitation, resurfacing or restoration project under STP may be used for environmental mitigation, pollution abatement or construction of storm water treatment systems. This equates to $6.7 billion in potential STP funding over six years. In addition, states may use STP and National Highway System (NHS) funds for wetlands projects designed to offset impacts from past transportation projects. Depending on specific program requirements, both TE and restoration projects are cost-shared between Federal and Non-Federal sponsors, with an 80% Federal share.

State

Special Area Land Treatment Program: The Special Area Land Treatment (SALT) Program, funded by half the proceeds of a one-tenth of a percent Parks and Soils sales tax in Missouri, allows Soil and Water Conservation Districts to target watershed areas to improve, protect and maintain the water quality of Missouri using a watershed based approach. The SALT program offers technical assistance, financial assistance and project grants in designated watersheds to encourage resource conservation and adoption of best management practices to accomplish project goals (see Appendix I, Watershed Implementation).

Practices used include traditional soil conservation practices, integrated crop management, filter strip establishment, riparian corridor management, animal waste management systems and other specially approved project practices. It is estimated an average of $10 million per year will be available through 2008 to support approximately 120 agricultural SALT projects.

Sources of Funding
(In millions)

	FY2001	FY2002	FY2003	FY2004	FY2005
Section 319(h) & (I)					
Base	$3.0	$3.0	$3.0	$3.0	$3.0
Incremental	$2.3	$2.3	$2.3	$2.3	$2.3
Section 104(b)	----	----	----	----	----
CWA SRF	$10	$10	$10	$10	$10
SDWA SRF	$1.24	$1.24	$1.24	$1.24	$1.24
TEA-21	$645.8*	*a percentage of this can be used for WQ/environment			
SALT Program	$6.8	$6.8	$6.8	$6.8	$6.8

Maintenance of Effort

The Water Quality Act required the state to maintain its funding for NPS management at or above the average of its NPS management funding for FY 1986 and FY 1987. There were no state funded NPS activities during that period; therefore, Missouri's "Maintenance of Effort" level is zero dollars. State water pollution control and land reclamation expenditures were federal dollars. Soil and water conservation efforts, while state supported, were directed entirely to soil erosion control and prevention.

Realizing that a "Maintenance of Effort" level of zero dollars is unacceptable, this issue is addressed in the NPSMP goals and objectives. Goal C, Objective 5 of the NPSMP is to maintain funding of NPS activities at or above 1999 levels.

VIII.

Milestones

Goal A: **For at least the next 5 years, continue and enhance statewide water quality assessment processes to evaluate water quality and prioritize watersheds affected by nonpoint source (NPS) pollution.**

Objective 1

Periodically assess and prioritize watersheds in need of restoration due to NPS pollution based on available methodologies.

Lead Agency(ies): Clean Water Commission, DNR, NRCS
Projected Completion: Ongoing – every 2-3 years
Status:

Objective 2

Continue to improve water quality monitoring methods used to assess NPS pollution.

Lead Agency(ies): DNR
Projected Completion: Ongoing
Status:

Objective 3

By 2001, develop and propose to the Clean Water Commission numeric biological criteria, as a water quality standard, to better identify those impacted wadable streams incapable of supporting the expected biological community.

Lead Agency(ies): DNR
Projected Completion: December 2001
Status:

Objective 4

Publish a report of water quality assessment efforts using improved methodologies by 2005.

Lead Agency(ies): DNR
Projected Completion: December 2005
Status:

Objective 5

Coordinate with USEPA to develop nutrient criteria and propose those criteria as water quality standards by 2003.

Lead Agency(ies): DNR
Projected Completion: December 2003
Status:

Goal A: Objective Performance Measures

2000	2001	2002	2003	2004

Production of 303(d) list

Production of 305(b) report

Updated Unified Watershed Assessment

Establishment of biocriteria as water quality standards

Establishment of nutrient criteria as water quality standards

Number of TMDL studies completed

Number of watersheds with ambient monitoring

Number of watersheds with biological and habitat assessment

Number of ambient monitoring sites by ecoregion

Number of sites with biological and habitat assessment by ecoregion

Number of watersheds with ambient, biological, and habitat assessments

Number of watershed water quality models of NPS pollutants developed

Goal A: **Implementation Strategies**	**Participating Agency(ies)**	**Status**
Coordinate with NPS partners to develop biocriteria and nutrient criteria	**DNR** **MDC** **UOE**	
Continue statewide monitoring of aquatic flora and fauna	**DNR** **MDC**	
Conduct special studies of habitat and fish communities	**DNR** **MDC**	
Conduct fish tissue sampling	**MDC** **DOH**	
Collect, manage and disseminate quality assured water quality data	**DNR** **DOA** **MDC** **UOE**	
Support training of volunteers	**DNR** **MDC** **UOE** **NRCS**	
Continue monitoring on the Missouri and Mississippi Rivers	**MDC**	
Review available data and watershed priorities	**DNR** **DOA** **MDC** **NRCS**	
Review existing water quality standards every 3 years	**DNR** **MDC**	
Develop a watershed prioritization tool useful at the 14-digit HUC level of detail	**DNR** **MDC** **NRCS**	

Continue to develop aquatic macroinvertebrate biocriteria	**DNR** **MDC**	
Maintain the level of effort and cooperation achieved for water quality monitoring and water quality data management at or above FY 2000 levels.	**DNR** **DOA**	
Participate in USEPA Region 7 nutrient criteria workgroup	**DNR** **MDC** **NRCS**	
By 2004, complete at least 20 TMDL studies	**DNR**	
Facilitate the development and use of watershed water quality modeling of NPS pollutants such as contaminated sediments, suspended sediment, pesticides and nutrients	**DNR** **DOA** **MDC** **UOE** **NRCS**	

Goal B: **Improve water quality by implementing NPS-related projects and other activities.**

Objective 1

By 2004, 25% of waters listed on the 1998 303(d) list due to NPS pollution will meet water quality standards.

Lead Agency(ies): DNR and NPS partners
Projected Completion: December 2004
Status:

Objective 2

By 2014, 75% of waters listed on the 1998 303(d) list due to NPS pollution will meet water quality standards.

Lead Agency(ies): DNR and NPS partners
Projected Completion: December 2014
Status:

Objective 3

Reduce potential nonpoint sources of groundwater contamination.

Lead Agency(ies): DNR and NPS partners
Projected Completion: Ongoing
Status:

Objective 4

Cooperate and collaborate with other resource programs, agencies and private partners to prevent, manage, and reduce nonpoint sources of pollution.

Lead Agency(ies): DNR and NPS partners
Projected Completion: Ongoing
Status:

Objective 5

Encourage environmental stewardship through information and education.

Lead Agency(ies): UMC Extension and NPS partners
Projected Completion: Ongoing
Status:

Objective 6

By December 2004, initiate 20 or more locally led watershed projects incorporating water quality protection, restoration, or voluntary TMDL action plans.

Lead Agency(ies): USFS, DNR, NRCS, USFWS, UMC Extension
Projected Completion: December 2004
Status:

Objective 7

By 2009, begin implementing at least 20 locally led voluntary TMDL action plans.

Lead Agency(ies): Contacts for projects initiated in Objective 5
Projected Completion: December 2009
Status:

Objective 8

Support pollution prevention efforts to sustain water quality of outstanding state or national resource waters.

Lead Agency(ies): DNR and NPS Partners
Project Completion: On-going
Status:

Objective 9

Support pollution prevention efforts to sustain water quality of those waters that are close to meeting the criteria for being placed on the 303(d) list as impacted by NPS pollutants, but have not yet attained that status.

Lead Agency(ies): DNR and NPS Partners
Project Completion: On-going
Status:

Goal B: Objective Performance Measures

2000	2001	2002	2003	2004

Number of local or regional watershed alliances formed

Number of Special Area Land Treatment (SALT) agricultural NPS water quality projects approved by the Soil and Water Commission

Number of acres treated and best management practices applied as part of watershed projects and voluntary WQMP/TMDL action plans
Number of watershed projects initiated

Number of voluntary TMDL action plans implemented

Number of locally led watershed projects initiated

Number of locally led voluntary TMDL action plans implemented

Number of drinking water reservoirs in compliance with NPS-related drinking water standard

Quantifiable measures on a project-specific basis such as:

tons of soil saved
reductions in nutrients and pesticides applied (if appropriate)
reductions in pesticides and nutrients leaving the field

Number of nutrient management plans (NMP) implemented at animal feeding operations (AFOs)

Number of acres on which nutrients are applied in accordance with an approved NMP

Number or amount of State Revolving Fund loans used to prevent NPS pollution

Number of stream miles returned to compliance with water quality standards which were included on the 1998 list of impaired waters prepared under Section 303(d) of the federal Clean Water Act as a result of NPS pollution

Number of lake acres returned to compliance with water quality standards which were included on the 1998 list of impaired waters prepared under Section 303(d) of the federal Clean Water Act as a result of NPS pollution

Number of potential nonpoint sources of groundwater contamination controlled

Number of educational and informational activities conducted by government and private entities

Number of participants in educational and informational activities

Number of informational and guidance materials developed and distributed

Number of stream teams and Level I, II, and III volunteer monitoring teams

Number of abandoned wells certified as properly plugged

Number of source water protection plans

Number of acres protected by source water protection plans

Goal B: Implementation Strategies	Participating Agency(ies)	Status
Expand eligible uses of the State Revolving Loan fund programs to include prevention or control of nonpoint sources	**DNR** **DOA**	
Designate as top priority for funding assistance those waters included on the 303(d) list as impaired by nonpoint sources	**DNR**	
Support programs and training that provide communities and local leaders the tools to plan, fund and direct watershed protection and restoration efforts	**DNR** **DOA** **MDC** **UOE** **NRCS**	
Encourage and support locally led watershed projects that incorporate water quality protection, restoration, or voluntary TMDL action plans	**DNR** **DOA** **MDC** **UOE** **NRCS**	
Direct funding pursuant to section 319 of the Clean Water Act with maximum flexibility to complement resources available to the watershed from other programs and agencies	**DNR**	
Support development and adoption of innovative best management practices through resource management systems	**DNR** **DOA** **MDC** **UOE** **NRCS**	

Sponsor water quality information and education programs and materials	**DNR** **DOA** **MDC** **UOE** **NRCS**	
Offer technical assistance and cost share assistance as appropriate	**DNR** **MDC** **UOE** **NRCS**	
Support water quality, NPS issues training and technical certification processes for advisors to the public in related resource areas	**DNR** **DOA** **MDC** **UOE** **NRCS**	
Support activities promoting environmental stewardship in the manipulation of land by the developmental, agricultural and silvicultural communities	**DNR** **DOA** **MDC** **UOE** **NRCS**	
Actively seek collaborative NPS water quality protection projects that are likely to provide mutual benefits to participants and sponsors	**DNR** **MDC** **UOE** **NRCS**	
After revision of the Unified Watershed Assessment to make it a more usable tool, target Category 1 watersheds for voluntary TMDL action plans or WQMP plan implementation	**DNR** **NRCS**	

Advise local entities on the appropriate use of urban and suburban stream protection and stormwater sediment control resolutions and ordinances	**DNR** **MDC** **UOE** **NRCS**	
Promote pollution prevention and protection of waters in projects throughout the state.	**DNR** **MDC** **UOE** **NRCS**	
By 2004, integrate NPSMP goals and objectives into Phase II of the State Water Plan.	**DNR**	
Develop watershed restoration and protection strategies for priority areas where water quality is degraded by nonpoint source pollution due to karst topography.	**DNR** **MDC** **UOE** **NRCS**	

Goal C: **Maintain a viable, relevant, and effective NPS Management Program with the flexibility necessary to meet changing environmental conditions and regulations.**

Objective 1

Review and update the Nonpoint Source Management Plan (NPSMP) every five years.

Lead Agency(ies): DNR and NPS partners
Projected Completion: December 2004
Status:

Objective 2

Strengthen cooperation and collaboration with other resource programs, agencies and private partners.

Lead Agency(ies): DNR and NPS partners
Projected Completion: Ongoing
Status:

Objective 3

Use appropriate program and financial systems to ensure Section 319 funds are used consistently with legal obligations and environmental benefits are maximized.

Lead Agency(ies): DNR
Projected Completion: Ongoing
Status:

Objective 4

By 2004 identify federal lands and activities that are not managed consistently with state NPS objectives.

Lead Agency(ies): DNR, USFWS
Projected Completion: December 2004
Status:

Objective 5

Maintain funding of NPS activities at or above 1999 levels.

Lead Agency(ies): DNR and NPS partners
Projected Completion:
Status:

Goal C: Objective Performance Measures

2000	2001	2002	2003	2004

NPSMP is reviewed and updated in accordance with implementation schedule

Numbers and diversity of participants in the Water Quality Coordinating Committee meetings

Number and diversity of collaborators in development of NPSMP

Number of federal lands or activities inconsistent with the NPSMP and the number addressed of those lands or activities addressed

Status of GRTS reporting

Number of projects closed out properly

Number of MOA's signed

Procedural improvements identified and implemented

Amount of state funding directed to NPS activities

Amount of federal funding directed to NPS activities in Missouri

Goal C: Implementation Strategies	**Participating Agency(ies)**	**Status**
Organize and support meetings that provide a forum for sharing water quality and NPS information and technologies, such as the Water Quality Coordinating Committee, Watershed Committee of the Ozarks and others	**DNR** **DOA** **MDC** **UOE** **NRCS**	
Work with local authorities and landowners to achieve goals in the state NPSMP	**DNR** **MDC** **UOE** **NRCS**	
Capitalize on opportunities to provide input regarding NPS issues to other entities	**DNR** **DOA** **MDC** **UOE** **NRCS**	
Incorporate NPS-related goals of other groups and agencies in the NPS Management Program as appropriate and provide complementary assistance in achieving those goals	**DNR** **DOA** **UOE** **NRCS**	

Review and revise the NPSMP according to the following schedule: Annually review and, if appropriate, revise the assessment and monitoring strategy and funding sources in the NPSMP. Year two, review and update the implementation assistance and regulatory authorities. Year three, review and update remaining categorical sections such as land application of permitted wastes. Year four, review and revise goals and objectives and review legal certification of authority. Complete updates of any sections not revised during the preceding five years. Make appropriate revisions to the NPSMP as needed when changes in environmental conditions or regulatory authorities make the existing plan irrelevant or inappropriate	**DNR** **MDC**	

Use the Water Quality Coordinating Committee and other forums to review, comment, and participate in the NPSMP review and revision	**DNR** **DOA** **NRCS**	
Use the Clean Water Commission and public notice procedures to provide the opportunity for public review and comments to the revised NPSMP	**DNR**	
Maintain current information on Grant Reporting and Tracking System (GRTS)	**DNR**	
Periodic audits conducted	**DNR**	
Follow EPA guidelines in reviewing, prioritizing, funding and managing activities funded under section 319 of the Clean Water Act	**DNR**	
Suggest improvements to state and federal program guidelines when appropriate to enhance NPS management capabilities	**DNR** **MDC** **NRCS**	

APPENDIX A

Nine Key Elements

NINE KEY ELEMENTS

(Excerpted from "Nonpoint Source Program and Grants Guidance for Fiscal Year 1997 and Future Years," U.S. Environmental Protection Agency, Office of Water, Washington, D.C., May 1996.)

EPA and the state lead nonpoint source agencies agree that the following nine key elements characterize an effective and dynamic state nonpoint source program. Each key element appears in bold type and is then followed by explanatory text that elaborates on the key element. The explanatory text provides information on means by which the states may choose to implement the key element.

All states will review and, as appropriate, revise their nonpoint source management programs in a manner that reflects these nine key elements. States will then submit their upgraded programs to EPA for approval. As discussed below in Sections III-B and V of this guidance, states that successfully incorporate these nine key elements into their programs and have a proven track record of effective implementation will be recognized Nonpoint Source Enhanced Benefits States and be provided maximum flexibility in implementing their programs and other benefits.

1. **The state program contains explicit short- and long-term goals, objectives and strategies to protect surface and groundwater.**

   The state's long-term goals are consistent with the national program vision that all states implement dynamic and effective nonpoint source programs designed to achieve and maintain beneficial uses of water. The shorter-term objectives consist of activities, with milestones, that are designed to demonstrate reasonable further progress that leads to accomplishment of the long-term goals as expeditiously as possible. The state program includes objectives that address nonpoint sources of groundwater pollution. The objectives list both implementation steps and the results to be achieved (e.g., water quality improvements or load reductions).

   The state program includes long-term goals; shorter-term (e.g., 3- to 5-year) objectives that are periodically updated based on progress, strategies to achieve progress toward achieving the goals and objectives, indicators to measure progress and annual work plans to implement the strategies.

2. **The state strengthens its working partnerships and linkages to appropriate state, interstate, tribal, regional and local entities (including conservation districts), private sector groups, citizen groups and federal agencies.**

   The state uses a variety of formal and informal mechanisms to form and sustain these partnerships. Examples include memoranda of agreement, letters of support, cooperative projects, sharing and combining of funds and meetings to share information and ideas.

The state nonpoint source lead agency works collaboratively with other key state and local nonpoint source entities in the development and implementation of the section 319 management program and actively involves them in decision making. Interagency collaborative teams, nonpoint source task forces and representative advisory groups have all proven effective for accomplishing these linkages, especially where they meet on a regular basis and are managed in a collaborative and inclusive manner.

Further, the state seeks public involvement and comment on significant proposed program changes and engages in public education activities to promote public awareness of nonpoint source pollution and its solutions. As appropriate, representatives are involved from local, regional, state, interstate, tribal and federal agencies; public interest groups, industries, academic institutions, private landowners and producers, concerned citizens and others. This involvement helps ensure that environmental objectives are well integrated with those for economic stability and other social and cultural goals.

3. **The state uses a balanced approach that emphasizes both statewide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened.**

The state nonpoint source management program emphasizes a watershed management approach and is well integrated with other important programs to protect and restore water quality. These include point source, ground water, drinking water, clean lakes, wetlands protection and national estuary programs; coastal zone programs; conservation and pesticide management programs; forestry programs; and other natural resource and environmental management programs.

Each state has the flexibility to design its nonpoint source management program in a manner that is best suited to attain and maintain beneficial uses of water. On-the-ground implementation of practices and programs is the best means of reducing and preventing pollution from nonpoint sources, but states may achieve this on-the-ground implementation by a combination of watershed approaches and state-wide programs. Similarly, as described more fully in key element 5 below, the state may use any combination of water-quality or technology-based approaches it deems appropriate to make progress toward attaining and maintaining beneficial uses of water.

4. **The state program (a) abates known water quality impairments from nonpoint source pollution and (b) prevents significant threats to water quality from present and future nonpoint source activities.**

The program is designed to remedy waters that the state has identified as impaired by nonpoint source pollution. Further, the program is designed to prevent new water quality problems from present and reasonably foreseeable degradation. State

programs should place a priority on protecting waters from future nonpoint source pollution as soon as possible (generally within 5 years).

5. The state program identifies waters and their watersheds impaired by nonpoint source pollution and identifies important unimpaired waters that are threatened or otherwise at risk. Further, the state establishes a process to progressively address these identified waters by conducting more detailed watershed assessments and developing watershed implementation plans, and then by implementing the plans.

The state identifies waters impaired by nonpoint source pollution based on currently available information (e.g., in reports under sections 305(b), 319(a), 303(d), 314(a) and 320, and revises its list periodically as more up-to-date assessment information becomes available. The state also identifies important unimpaired waters that are threatened or otherwise at risk from nonpoint source pollution.

In addition, the state identifies the primary categories and subcategories causing the water quality impairments, threats and risks. At 5-year intervals the state updates the identification of waters and their watersheds impaired or threatened by nonpoint source pollution, preferably as part of a single comprehensive state water quality assessment which integrates reports required by sections 305(b), 319(a), 303(d), 314(a) and 320.

The factors used by the state to progressively address its waters may include a variety of relevant environmental and administrative considerations, including, for example:

- human health;
- ecosystem health including ecological risk;
- the beneficial uses of the water;
- value of the watershed or groundwater area to the public;
- vulnerability of the surface or groundwater to additional environmental degradation;
- likelihood of achieving demonstrable environmental results;
- implementability;
- extent of alliances with other federal agencies and states to coordinate resources and actions; and
- readiness to proceed.

The state links its prioritization and implementation strategy to other programs and efforts as appropriate. Examples include total maximum daily loads, clean lakes programs, comprehensive groundwater protection programs, source water protection programs, wetlands protection programs, national estuary programs, ambient monitoring programs and pesticides management programs. Related programs administered by agricultural, forestry, highway and other agencies should also be linked, for example, USDA’s Water Quality Initiative, PL-534 and PL-566 Watershed Projects and the Northwest Salmon Initiative. In establishing priorities

for groundwater activities, the state considers wellhead protection areas, groundwater recharge areas and zones of significant groundwater/surface water interaction.

More detailed information on priority setting is also contained in pp. 11 and 12 of the December 1987 Nonpoint Source Guidance; Setting Priorities: The Key to Nonpoint Source Control (EPA, 1987); Selecting Priority Nonpoint Source Projects: You Better Shop Around (EPA, 1989); Geographic Targeting: Selected State Examples (EPA, 1993) and Watershed Protection: A Project Focus (EPA, 1995).

6. The state reviews, upgrades and implements all program components required by section 319(b) of the Clean Water Act, and establishes flexible, targeted and iterative approaches to achieve and maintain beneficial uses of water as expeditiously as practicable. The state programs include:

- A mix of water quality-based and/or technology-based programs designed to achieve and maintain beneficial uses of water; and

- A mix of regulatory, non-regulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.

Section 319(b) specifies the minimum contents of state nonpoint source management programs. These include:

(i) An identification of the measures (i.e., systems of practices) that will be used to control nonpoint sources of pollution, focusing on those measures which the state believes will be most effective in achieving and maintaining water quality standards. These measures may be individually identified or presented in manuals or compendiums, provided that they are specific and are related to the category or subcategory of nonpoint sources. They may also be identified as part of a watershed approach toward achieving water quality standards, whether locally, within a watershed or state-wide;

(ii) An identification of programs to achieve implementation of the measures, including, as appropriate, non-regulatory or regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer and demonstration projects. States should establish a flexible, targeted approach to solve their water quality problems. States have the freedom to decide the best approaches for solving the problems that they identify under key element 5 above. These approaches may include one or all of the following:

- watershed or water quality-based approaches aimed at meeting water quality standards directly;

- iterative, technology-based approaches based on best management practices or measures, applied on either a categorical or site-specific basis; or

- an appropriate mix of these approaches.

(iii) A description of the processes used to coordinate and, where appropriate, integrate the various programs used to implement nonpoint source pollution controls in the state;

(iv) A schedule with goals, objectives and annual milestones for implementation at the earliest practicable date: legal authorities to implement the program; available resources and institutional relationships;

(v) If the state program is changed substantially, certification by the Attorney General or designee;

(vi) Sources of funding from federal (other than section 319), state, local and private sources;

(vii) Federal land management programs, development projects and financial assistance programs (see key element 7 below); and

(viii) A description of the monitoring and other evaluation programs that the state will conduct to help determine short- and long-term program effectiveness.

<u>In addition, state nonpoint source programs must incorporate existing baseline requirements established by other applicable federal or state laws to the extent that they are relevant</u>. For example, coastal states and territories should include or cross-reference approved state coastal nonpoint source programs required by section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990. In this manner, states can make sure that these coastal nonpoint source programs and other relevant baseline programs are integrated into section 319 programs, and that they are eligible for section 319(h) grant funding, which is limited by section 319(h)(1) to “the implementation of approved section 319 programs.”

All of these components should be identified by the state, included in the state nonpoint source management program and be reviewed and approved by EPA under section 319 of the Clean Water Act.

7. The state identifies federal lands and activities which are not managed consistently with state nonpoint source program objectives. Where appropriate, the state seeks EPA assistance to help resolve issues.

The state commits to reviewing and identifying those federal land management programs, development projects and financial assistance programs that are or may be inconsistent with the state’s nonpoint source management program.

As a federal agency, EPA has a special role to play in support of state nonpoint source programs by working with other Federal agencies to enhance their understanding of the significance of nonpoint source pollution and of the need to work cooperatively with states to solve nonpoint source problems. Where appropriate, EPA will help develop memoranda of agreement among states and federal agencies to help reduce nonpoint source pollution on federal lands and to better address nonpoint source pollution in federal assistance programs and development projects. In addition, where appropriate, EPA will assist in resolving particular issues that arise between the state and federal agencies with respect to federal consistency with the state nonpoint source management program.

8. The state manages and implements its nonpoint source program efficiently and effectively, including necessary financial management.

The state implements its program to solve its water quality problems as effectively and expeditiously as possible. Timeliness is key to accomplishing environmental objectives and demonstrating results as soon as possible. To help assure that priority water quality problems are addressed cost-effectively and in a timely manner, the state includes in its program a process for identifying the critical areas requiring treatment and protection within watersheds selected for implementation activities and assigns the highest priority to addressing those areas.

The state employs appropriate programmatic and financial systems that ensure that section 319 dollars are used consistently with its legal obligations and generally manages all nonpoint source programmatic funds to maximize environmental benefits. The state ensures that section 319 funds complement and leverage funds available for technical and financial assistance from other federal sources and agencies.

9. The state periodically reviews and evaluates its nonpoint source management program using environmental and functional measures of success and revises its nonpoint source assessment and its management program at least every five years.

In its upgraded program, the state establishes appropriate measures of progress in its programmatic and environmental goals and objectives identified in key element #1 above. The state also describes a monitoring/evaluation strategy and a schedule to measure success in meeting those goals and objectives. The state integrates monitoring and evaluation strategies with ongoing federal natural resource inventories and monitoring programs.

Appendix A presents a guide for evaluating the effectiveness of state nonpoint source management programs, based on these nine key elements. Approaches to environmental indicators and monitoring are described below.

a. Environmental Indicators

States are encouraged to use several sets of measures to fully indicate their success in implementing their nonpoint source programs. These include measures that indicate progress toward achieving and maintaining beneficial uses of water toward long-term goals (e.g., successfully implementing a particular technology).

Appendix B contains an illustrative set of indicators and other measures that can help the states and the public gauge the progress and success of their programs. States may identify and use other indicators and measures that are most relevant to their particular nonpoint source problems, programs and projects. However, states are strongly encouraged to use environmental endpoints to the greatest extent feasible so that the state and the public may best recognize the state's progress in addressing water quality problems in terms that are most relevant to the public's concerns. In addition, as discussed in Section IV-D of this guidance, states must include in its annual reports at least the three measures of progress that are identified in section 319(h)(11), including implementation milestones, available information on reductions in nonpoint source pollutant loadings and available information on improvements in water quality.

EPA is currently developing a broad strategy for the use of environmental indicators for its various environmental programs, including its water programs. The list in Appendix B, while providing more detail on indicators that are of particular relevance to state nonpoint source programs, is consistent with the environmental indicators adopted nationally by EPA to measure progress toward environmental goals.

b. Monitoring in Watershed Projects

Appropriate monitoring of watershed project implementation is an essential tool to enable states to identify nonpoint source pollution problems and to evaluate nonpoint source program effectiveness. First, states need to identify sources, document the effectiveness of individual measures and BMP systems and develop watershed-level strategies to prevent and control nonpoint source pollution. Second, in the case of watershed projects intended to demonstrate a new or innovative technical or institutional approach to resolving nonpoint source water quality problems, monitoring is needed to develop the information and data necessary to demonstrate the project's effectiveness and the applicability of the approach elsewhere. Third, monitoring is needed to help states meet the annual reporting requirements of the section 319(h)(11), especially information on reductions in nonpoint source pollutant loading and improvements in water quality. Therefore, an appropriate type of monitoring should be considered for watershed projects funded with section 319 grants.

Major watershed projects should include some form of tracking or monitoring to evaluate effectiveness. Watershed implementation plans should include clearly stated monitoring objectives and an evaluation strategy making clear what the state expects to learn as a result of its evaluation of the project. The evaluation approach may be tailored to the specific project, based on factors such as the project's size and objectives. Approaches that can be used to meet the project evaluation needs include ambient water quality monitoring (e.g., edge-of-field, small watersheds, multiple watersheds, in-lake, in-aquifer monitoring), beneficial use assessment (e.g., biological/habitat assessment, attainment of water quality standards), implementation monitoring (e.g., audits, activity tracking, geographic information system tracking of land use and land management), model projections and photographic evidence. Ambient monitoring and beneficial use assessment tracking should be included for projects wherever feasible.

While states may use Section 319(h) grant funds for monitoring activities for particular watershed projects, states are encouraged to also explore other approaches to conducting monitoring. For examples, the U.S. Geological Survey and the National Oceanic and Atmospheric Administration holds an array of ambient data and can provide support for various monitoring activities, and volunteer monitoring programs are a useful resource in many states.

APPENDIX B

Plan Development and Review

PLAN DEVELOPMENT & REVIEW

Development Process and Public Participation

Missouri's Nonpoint Source Management Plan was prepared by the Missouri Department of Natural Resources and approved by EPA in 1989 in response to the requirements of Section 319 of the federal Water Quality Act of 1987. Changes over the last ten years have prompted DNR to revise the plan to reflect current natural conditions and administrative procedures in Missouri. This revised plan is a product of the process followed and discussed below.

The Missouri Nonpoint Source Management Plan was and will continue to be developed with participation from nonpoint source partner agencies, organizations, and the public. This cooperative effort is fundamental to the success of this plan. Federal, state, and local agencies and private organizations were contacted through memorandum, meetings, email, and telephone conversations. This revision has proceeded over a three-year period with many work group meetings related to specific topics and many related documents taken into account. Representatives from each agency and organization were invited to participate in the Nonpoint Source Management Plan workgroup to develop the strategic plan, review drafts and comments, and to contribute information on their NPS related goals and objectives. Public involvement in the NPSMP was provided through the public notice and comment process. The general public was notified of the plan's availability through press releases and DNR's website. The public was able to obtain a hard copy from the Water Pollution Control Program or it could be viewed and printed from DNR's website. The Missouri Clean Water Commission was provided copies of each draft section at the time each was completed.

Review, Comments and Responses

A preliminary draft was provided for review to representatives of NPS partner agencies and organizations in the spring of 1998. A list of those representatives invited to participate in the review, comments received, and responses may be found at the end of this section. All comments were reviewed and changes were made to the draft where necessary. Only comments that were not incorporated into the draft are listed.

A second draft was provided for review to the public in February 1999. A list of those who requested copies of the plan or submitted comments is provided following the interagency review comments. All comments received and responses are also provided. Due to substantial changes to the document following this first public review period, a second public review period was opened in May-June 1999. Comments received during this these two public review periods follow the list of comments received during the interagency review.

A final draft of the plan was presented for approval to the Missouri Clean Water Commission in July 1999. A commission approved draft was sent to EPA in August 1999 for final review and approval. EPA approved the final draft by October 1, 1999. Missouri's NPSMP will continue to be reviewed and updated using the framework outlined in the strategic plan.

INTERAGENCY REVIEW DISTRIBUTION LIST

- * American Fisheries Society
- * Assistant Attorney General
- Conservation Federation of MO
- * DNR-Air Pollution Control Program
- * DNR-Division of Energy
- DNR-Division of Environmental Quality
- DNR-Division of Geology and Land Survey
- DNR-Environmental Services Program
- * DNR-Hazardous Waste Program
- DNR-Jefferson City Regional Office
- DNR-Kansas City Regional Office
- * DNR-Land Reclamation Program
- DNR-Northeast Regional Office
- * DNR-Public Drinking Water Program
- DNR-Soil and Water Conservation Program
- * DNR-Solid Waste Management Program
- DNR-Southeast Regional Office
- DNR-Southwest Regional Office
- DNR-St. Louis Regional Office
- DNR-Technical Assistance Program
- * JD Information Services
- Kansas City Water Services Dept.
- * Lincoln University Extension
- * Mark Twain National Forest
- * Metropolitan St. Louis Sewer
- Mid-America Dairymen Inc.
- MO Ag Industries Council, Inc.
- MO Chamber of Commerce
- MO Corn Growers Association
- MO Dairy Association
- * MO Department of Agriculture
- * MO Department of Conservation
- * MO Department of Health
- * MO Farm Bureau Federation
- MO River Communities Network
- MO Soybean Programs
- Monsanto Co- Q2F
- National Park Service
- * Novartis Crop Protection
- Ozark Mt. Center for Environmental Education
- * REGFORM
- Show-Me Clean Stream
- Springfield City Utilities
- * UMC Outreach and Extension
- * USDA-Farm Service Agency
- * USDA-Natural Resources Conservation Service
- US EPA Region VII
- US Fish and Wildlife Service
- * US Forest Service
- * US Geological Survey
- Watershed Committee of the Ozarks

*Agencies/organizations that participated in review

INTERAGENCY REVIEW COMMENTS AND RESPONSES

Comments received during the interagency review (Spring 1998):

Many comments and suggestions were received after the first review and most of them were incorporated into the plan. The comments listed below are those that were not incorporated into the plan or those requiring a response for some other reason. They are listed by section or topic following the outline of the plan. Comments are bolded and italicized. Some of the comments listed will be discussed further by the workgroup and may be incorporated into the plan at a later date.

NINE KEY ELEMENTS OF AN EFFECTIVE STATE PROGRAM

The Nine Key Elements on an Effective State Program is a guidance document provided by EPA and cannot be revised at the state level. Responses will be directed toward making the Missouri approach to meeting those elements fit the needs of the state.

Item 4. The last comment in this point should be: (generally within 10 years with biannual trends point the direction towards removing the known water quality impairment.) Five years may not be long enough to design the remedy program.

Item 4. Five years may not be sufficient amount of time for full implementation of a remedy program. Longer term programs may be necessary with short term benchmarks.

Response: When the Nine Key Elements were originally developed by a national NPS workgroup, there was a ten to fifteen year time frame outlined for bringing impaired waters back to fishable, swimmable, and drinkable state. Workgroup members recognized that schedule as being unrealistic and took out the endpoint. This element as it is currently written is intended to strongly encourage states to put in place within 5 years practices or controls necessary to prevent new or additional degradation while gathering necessary data on existing impairments and implementing management strategies to bring waters back into compliance

Item 6. "Regulatory" in the context of NPS programs under 319(b) should be the acceptance of a voluntary farm plan for agriculture implemented by farmers in the targeted watershed. This means that agriculture still needs the non-regulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable. It does not need command and control of land use.

Response: The Nine Key Elements have provided the flexibility for states to plan to achieve beneficial uses of water in whatever manner best suits the state so long as the time frames are reasonable. Missouri's NPS Plan contains a template for voluntary water quality management plans which can meet the requirements of TMDLs. It also contains goals and objectives which call for providing funding for technical and financial assistance to those in watersheds designated as priorities.

NPSMP GOALS, OBJECTIVES, AND MEASURES OF SUCCESS

Many of the comments on this section were directed at the strategic plans of the NPS partners. The strategic plans are presented verbatim and cannot be edited by DNR. Reviewers were directed to a representative of the agency and encouraged to contact them to address issues further.

(Partners' Goals, Pg 11 under evaluation plan) Emphasis of evaluation for community water supplies should not be based solely on atrazine SDWA compliance rather on all constituents listed for monitoring that is of concern for nonpoint contribution. (Theme 2, pg 12) Reduce the use of row crop pesticides by 5%...... What is the unit of measurement of 5%? Is it total pounds of active ingredient or acres applied etc.? (Part 3 of implementation plan pg 12) Low volume and low rate pesticide technology should only be one portion of demonstrations and trainings. Lower rates depending on the products does not necessarily equate to enhanced water quality. (Theme 4 pg. 24) Strike out the word "safe" and replace with "proper" (Objective A10 part 1, pg.31) strike out "state" and replace with new name "pesticide" so it reads Pesticide Management Plan.

Response: The comments you have made on this section refer to the strategic plans of University Extension and the Missouri Department of Agriculture. As such, we can not make changes to the document or address your questions adequately. University Extension will be revising their strategic plan this winter. If you would like the opportunity to participate and address the issues you raised you may contact Bob Broz, Water Quality Program Director, at (573) 882-0085. The Missouri Department of Agriculture just sent us an update of their strategic plan which will be incorporated into the next draft NPSMP. You may contact Sarah Tyree at (573) 751-2477 if you would like to address the issues you raised regarding their plan or have any further questions.

P1, 2008 goal: It seems somewhat strange that biocriteria won't be developed until 2008. How would you document that 25% of streams had reached goals of attainability? The measurement of attainability is very dependant on biocriteria. We are surprised that the macroinvertebrate criteria is taking this long...we are far, far behind other states in this regard. Perhaps this could be handled in a re-prioritization of funds.

Response: The goals and objectives in this draft are just a skeleton and will change as we get input from reviewers and as the workgroup starts meeting. We would appreciate your input at these meetings. This comment has showed up more than once and will definitely be addressed by the workgroup.

P1, A Objective, Strategies: Several problems here. Your objective measures suggest invertebrate monitoring by DNR and volunteer groups, yet invertebrates are not listed in the list of strategies. Fish are mentioned 4 times. To my knowledge DNR is working with invertebrates for biomonitoring, yet has not started with fish. The Department of Conservation, Department of Health, and other agencies are working with these elements of the fish community. The status of goals of invertebrate and fish biomonitoring need to be clarified because there are large differences in terms of status and organizational progress in this area.

Response: Same as above. Your participation in the workgroup would be appreciated.

P4, C Objective: These could be more quantitative (see University Extension section). For example, objective measure #1 could be changed to "Increase number of workshops by 10% per year to insure that 50% of teachers and youth leaders have had training by the Year 2003".

Response: This issue will be discussed further in workgroup meetings.

P6, para 1: Shouldn't this say "lots of at least three acres are exempt from construction standards...unless required by ordinances developed at the county level."?

Response: We do not have the authority to make edits to the strategic plans of other agencies. Your comment was directed at the Missouri Department of Health's strategic plan which is presented verbatim. I would encourage you to contact Daryl Roberts at (573) 751-6400 if you would like to address this issue with the MDOH.

P9-26: This section, developed by the University Extension, is much clearer in terms of objectives, strategies, implementation plans, and measures of success compared to the first section concerning DNR programs. It would greatly improve the document if the DNR section and those of other agencies were organized similarly.

Response: We can't change the other agencies' plans but the DNR section could be modified. This can be discussed in the workgroup.

P11, last 2 lines: This should say "e.g." to indicate that this is only one example or else expanded. There are many other ways to evaluate the effectiveness of community water supply programs.

Response: This comment refers to the strategic plan of University Extension which we cannot change. They will be revising their plan this winter. If you would like to participate or address the issues you have raised you may contact Bob Broz, Water Quality Program Director, at (573) 882-0085.

P23, para 2: Items in parenthesis appear to be editorial comments not totally resolved. Please change. Similar notes for page 25 under solid waste.

Response: Same as above.

P27 to 31: The Missouri Department of Agriculture component should be deleted as it does not really address the benefits of non-point source pollution prevention. Rather, it is delivered in a verbal format that detracts from the overall goals of this document. Neither Strategic Issue I nor II addresses NPS pollution. Strategic Issue III appears as a book-keeping exercise only directed at minimal efforts. Strategic Issue IV is delivered in a confrontational manner that indicates that environmental protection is an impediment as opposed to a goal (e.g. Goal 2 should read: "Resolve agricultural issues as they impact the environment. Strategic Issue V

(incorrectly listed as I) implies that bad science has led to a mis-perception of environmental impacts of agriculture."

Response: The NPSMP is a plan for the state and should include the NPS related goals/ objectives of all the partners. In the partners' plans, a reference is given in parentheses to the overall NPS plan. This is to indicate where their objectives/strategies overlap or enhance the plan. The Department of Agriculture's newest strategic plan, which will be included in the next draft of the NPSMP, is more in line/has more overlap with the NPSMP.

Under Goals for NPSMP, page 14, A. Water Degradation by Animal/Poultry Waste, Objectives: Add:

> ***3. Evaluate and implement alternative uses of animal waste***
> ***4. Evaluate application rates and assimilation capacities to reduce nutrient runoff and aquatic impacts.***

Response: Your comment addresses the strategic plan of University Extension. All of the excerpts of plans of other agencies in the NPSMP are typed verbatim. We do not have the authority to modify their plan. University Extension will be updating their plan this winter. If you would like to participate and/or address the comments you made, please contact Bob Broz, Water Quality Program Director, (573) 882-0085.

Under B. Water degradation by Mineral Elements (Plant Nutrients) on page 15 of the Goals for NPSMP, isn't a 10% reduction in fertilizer use minimal since half or more of nutrients may move off the site with runoff? Why not 25% or greater reduction as a goal?

Response: Same as above.

Under Goals for NPSMP, page 30, Add: "Objective A11: Work with the University of Missouri and other entities to conduct research on reducing pesticide, herbicide, and fungicide runoff."

Response: Your comment addresses the strategic plan of the Missouri Department of Agriculture which we do not have the authority to change. They have just revised their plan and it will be incorporated into the next draft of the NPSMP. I would encourage you to contact Sarah Tyree of DOA at (573) 751-2477 if you would like to address the issues you raised.

In-text #4: Goals for NPSMP, p. 13, Theme 3: Nutrients & Bacterial Wastes, para. 2, line 3: "The Missouri approach to..., has been successful." The validity of this statement is questionable.

Response: This information is taken from University Extension's strategic plan. I would encourage you to contact Bob Broz (see earlier response) to address this issue.

Under the Educational Opportunities objective, we think you should add a strategy, or expand an existing strategy, to cover sponsorship or support of permanent environmental education displays, such as the one being constructed at the Springfield Discovery Center.

Response: This comment will be considered by the NPSMP workgroup which will begin meeting in the near future.

Page 2 - line 10 "..albeit with a very low quality of information.." Does "low quality" mean small amount or poor quality data?

On page 2, the reference to "a very low quality of information" could be phrased more positively; we may need to rely on this information in legal proceedings so it would be best not to denigrate it in the plan. I suggest the following phrase: "albeit better information would improve the assessment" or words to that effect.

Response: This statement will be revised in the next draft. Low quality means that the type of data collected and the amount collected at this point is probably not sufficient for assessing the state's waters for NPS impairments.

Page 11, Item B, Objectives: -Replace "By 2000, convince 15...districts to develop.." with "By 2000, 15...districts will develop..."

Response: This comment addresses University Extension's strategic plan which we do not have the authority to modify. They will be modifying their plan this winter. I would encourage you to contact Bob Broz, Water Quality Program Director, at (573) 882-0085 if you would like to participate in that process.

Theme 3: Nutrients and Bacterial Wastes, B. Water Degradation by Mineral Elements (Plant Nutrients). Comment regarding Lincoln University's plant nutrition program.

Response: Thank you for the information regarding your program. Your program's input during the workgroup meetings would be appreciated. This comment addresses University Extension's strategic plan which is typed verbatim. I would again encourage you to contact Bob Broz and discuss your comments with him further.

Theme 4: Surface/Groundwater and Watershed Protection. Comment regarding Lincoln University's plant nutrition program.

Response: Same as above.

How will we achieve the NPS goal of reducing by 25% the waters not fully attaining all beneficial uses due to NPS by 2008 if our watershed identification will not be done until 2008 (p.1)?

Response: The goals and objectives in this first draft are just a skeleton and will change as we receive feedback and as the workgroup convenes. Several other reviewers have had the same comment regarding this goal. The workgroup will certainly address this issue and would appreciate your input.

On page 6, with respect to on-site sewage disposal, the phrase, "but there is no authority for assuring systems are maintained" should be amended to read "but there are significant practical and legal obstacles to maintaining systems." In a particular case, we may want to argue implicit legal authority to enforce system standards despite the lack of express statutory authority. The proposed change keeps that door open.

Response: This comment is directed at the Department of Health's strategic plan which we do not have the authority to change. All of the plans in the NPSMP from other agencies are typed verbatim. I would encourage you to contact Daryl Roberts from MDOH at (573) 751-6400 if you would like to discuss this issue further.

On page 12, the phrase "Hazardous (Toxic) Material" is used with respect to pesticides. This phrase is not known in the law. Missouri law recognizes "hazardous substances", which definition could include pesticides. See section 260.565, RSMo 1994. The Federal Toxic Substances Control Act regulates "chemical substances," which does not include pesticides. See 15 U.S.C. section 2602(2). I suggest using the term "hazardous substances" or "pesticides."

Response: This comment addresses the University Extension's strategic plan which we do not have the authority to modify. They will be modifying their strategic plan this winter and if you would like to participate or bring your comments to their attention please contact Bob Broz, Water Quality Program Director, at (573) 882-0085.

On pages 23-24, the plan discusses biological resources with only a fleeting reference to chip mills. Innovative legal strategies may be required to stem this potential threat to water quality. The objectives and implementation plan should include legislative initiatives to provide incentives and regulation of chip mills as well as to encourage cooperative and creative legal problem solving using available enforcement tools.

Response: Same as above.

On pages 25-26, the plan discusses compostable waste disposal. The objectives and implementation section should recognize and foster the leadership role of Northwest Missouri State University's biomass energy program. More research and demonstration by Northwest will help create markets and data to support solids separation, composting and renewable energy. In turn, water quality will benefit.

Response: Same as above.

The excerpt on page 27, Increased Production of Livestock, seems out of place and should be deleted.

Response: The Missouri Department of Agriculture has submitted a more recent edition of their strategic plan which will be incorporated into the next draft of the NPSMP. This plan is more in line with the goals and objectives of the NPSMP. This issue will be discussed further in the workgroup meetings.

On page 29, dead animal disposal must be in compliance with Chapter 644 as well as Chapter 269, RSMo. The department should take advantage of this opportunity to clarify this jurisdictional overlap with the Department of Agriculture, possibly through the workgroup.

Response: We can't change their plan but we can discuss this issue in the workgroup.

The objectives regarding pesticides on pages 30-31 may conflict with the more ambitious objectives expressed earlier in the plan. Perhaps this is another area for discussion by the workgroup.

Response: Same as above.

On page 41, the plan refers to "several significant animal waste spill" occurring "[r]ecently." In fact, the most significant animal wastewater spills occurred a few years ago. In addition, process water, not animal waste, was spilled in those instances. The animal agriculture lobby will raise these points, so perhaps we should clarify them now. I suggest qualifying the sentence by referring to "relatively recent" spills of "animal wastewater", "lagoon water" or "animal waste and lagoon water" for example.

Response: This issue is directed at the USDA - Natural Resources Conservation Service's strategic plan. We do not have the authority to change it. The contact for the Natural Resources Conservation Service is Bob Ball, (573) 876-0900. Please contact him if you would like to address this issue further.

Under UNIVERSITY EXTENSION, while they are the education agency it seems that partnering, and coordination of agencies might be improved. Under implementation, interacting with DNR, MDOH, NRCS, and SWCD boards is mentioned.

Under Theme 1: Drinking Water Supply, A. Private Water Supply, p.9, an objective to instruct prospective new well owners on state water well standards is discussed without mention that DGLS has current regulatory authority under RSMo. 256.600-256.640, and offers guidance to individuals and requires certification of any driller/installer working in Missouri. It further states 75 percent will employ certified drillers, without indicating what the current percentage is?

Under Theme 1: Drinking Water Supply, C. Community Water Supply, p.11, the objective of providing assistance and information to communities with municipal water supplies is discussed, without any apparent reference to assistance available from the DNR, Public Drinking Water Program.

Under Theme 2: Hazardous (Toxic) Materials, p.12, the paragraph mixes agricultural pesticides and household pesticides. An estimate and source of agricultural usage is provided, while a generalized statement implies, without any reference that households of five million people have all forms of pesticides, and most likely will be irresponsible in their use and/or disposal of such products. This should be rewritten with some recognition to the ongoing programs encouraging responsible use and disposal of household hazardous waste. The DNR, Technical Assistance Program provides assistance in this area, as well as many communities that stage and conduct household hazardous waste collection points on specified days.

Under Theme 2: A. Water Degradation from Pesticides, item 3., p. 12, objective is to reduce use of row crop pesticides by 5 percent. Again this is a general statement that implies all pesticides must be harmful, and all of them contaminate waters of the state. Is there no information on fate and transport of various pesticides, as well as toxicity considerations? In other words, some pesticides are much more harmful to human health and environment than others. The Public would probably like to see an effort to reduce the more harmful pesticides, or at least some logical wording used here to state this, if it is indeed what our real goal/objective is.

Under Theme 4: B. Irrigation, Chemigation, Well Development, Implementation item 6., p. 18, develop training for those installing irrigation wells and emphasize proper well construction? The certified well installer should already be familiar with proper well construction and plugging methods, as per existing regulations.

Response: This comment has several parts to it that all refer to University Extension's strategic plan which we do not have the authority to modify. They will be revising their plan this winter and if you would like to participate or have your comments addressed by them you may call Bob Broz, Water Quality Program Director, at (573) 882-0085.

Under Missouri Department of Conservation, p.33, what is Goal II? Is the reader to assume since it says (Excerpts), that Goal II had nothing to do with the NPSMP?

Response: Yes.

Page 1 (Objective Measures) add a point number 9: Number of voluntary TMDL action plans implemented.

Response: I believe your addition is addressed in objective B of the plan. The goals/objectives/ strategies will be changing over time as comments are received and changes are made during the workgroup meetings. Your input at these workgroup meetings would be appreciated.

NPS MANAGEMENT – MISSOURI'S APPROACH
Provide Tools.

It is important and I support the idea of "Safe Harbor" provisions discussed in this section.

Response: Thank you for your comments. Your input at the workgroup meetings would be appreciated.

The priority waters section of the report should clearly identify waters inhabited by federally listed species as priority waters. It would also be beneficial to include waters containing state listed Endangered species, as these species play an important role as indicators of water quality conditions and trends.

Response: Priority waters are identified through the development of the impaired waters list pursuant to section 303(d) of the federal Clean Water Act. The development of this list does not specifically take threatened or endangered species into account, although these species are subject to the same protections afforded others through the Missouri water quality standards. The impaired waters list is revised every two years and comments on how these species may be better addressed through that process are welcome.

Voluntary TMDL is an oxymoron, is it not? Maximum implies limit, and it is unlikely that local groups have the expertise, money, or desire to do such. Perhaps this should be "Voluntary Daily Loading Goal" or some other term.

Response: These TMDLs are voluntary in the sense that a local watershed group can agree to accept certain limitations that will solve the water quality problem on the group's terms, implementing its recommended methods on a mutually agreeable schedule. The limitations are binding and regulatory action may be taken if the solution is not implemented.

NONPOINT SOURCE CATEGORIES

AGRICULTURE

Animal Production

P1, para 3: There are more than 3 major areas and these are not necessarily the greatest concerns. As listed in the next paragraph, ammonia toxicity is a major problem that is not necessarily captured under the area of eutrophication or nutrient enrichment. Likewise, I'm not sure that "pathogens" has been proven to be an environmental impact on the level of riparian habitat modification, instream habitat modification, or ammonia toxicity. Similarly, one could argue that "riparian habitat disruption" is not related to "pastured animals" but rather "improperly pastured animals"... this is not a trivial distinction. The first section on the next page makes this point quite nicely.

Response: A separate discussion on ammonia has been added. "Improperly pastured animals" was not added as there is no agreed to criteria on pastures.

Nutrients/eutrophication (page 1) - - This section should be combined with the corresponding "Nutrients" section under crop production and cross referenced.

Response: This was not done so as to maintain a discussion in each section.

URBAN STORMWATER RUNOFF

First paragraph. I agree that sediment is the primary contaminant. Can it be stated that chemical and nutrient uses in urban areas also pose a threat to water quality.

Response: The first paragraph of this section, as well as the entire urban discussion, does refer to all types of pollution being present in urban stormwater. Therefore, we do not see the need to change this paragraph.

P.7, 3rd paragraph under Pesticides, Atmospheric deposition of pesticides in research that I am aware of is not known to be any problem to urban or rural watersheds by any research. Detection of pesticides in some studies can be in low parts per trillion but not of consequence and never linked to any stormwater concerns. The paragraph should be taken out.

Response: We have information that agricultural pesticides have been found in urban environments; therefore, we will leave this paragraph as is.

Urban storm water regulations, p. 2, USEPA is expanding the definitions of areas that come under regulation. What additional criteria or detail can be added to provide some explanation of the possible changes? What size of community, or other information?

Response: Since Phase II of the stormwater regulations is still in the process of ongoing negotiation, we decided it would be best to provide less information about the future of urban regulation, since anything in this document may change in the next year and lead to misleading or inaccurate statements. Therefore, that paragraph will be reworded to read:

> At this time, under Phase II of the stormwater rule, the USEPA may expand the definition of areas that come under regulation.

RESOURCE EXTRACTION

Under RESOURCE EXTRACTION, Water Quality Problems, the 128 miles affected by abandoned lead-zinc mines seems very conservative. Should a more accurate number be desired, please coordinate with the Hazardous Waste Program, Superfund Section.

Under RESOURCE EXTRACTION, Figure IV-2, Best Management Practices under Smelter Areas, we would suggest adding the separation of precipitation from process water, and contaminated water, thereby minimizing the commingled water that requires collection, storage, and treatment. Use of gutters and enclosures at some of the buildings, as well as reduced dumping of the ore in outside areas, would have possible application.

Response: Your suggestion has been implemented by adding the separation of precipitation from process water as a *Best Management Practice* under the *Smelter Areas* portion of Table 7 (formerly called Figure IV-2).

Under Resource Extraction/Sand and Gravel, Federal and State Authorities: The decision in American Mining Congress v. United States Army Corps of Engineers, No. 93-1754 SSH nullifies the joint EPA/COE rule regarding the definition of "incidental fallback" and removes much of the Corp's authority regulating dredging (see attachment).

Response: The *Resource Extraction/Sand and Gravel, Federal and State Authorities* section has been revised to discuss the regulatory roles of the Corps of Engineers and the Land Reclamation Program in light of the recent legal decision.

On Resource Extraction section: This section does not contain sections on subsurface mining or mine and mill tailings. Recently, the Missouri Chapter of the American Fisheries Society developed and approved a position statement on mining which includes these categories. A copy is enclosed. Some of the information concerning resource values, types of impacts, and state statistics on impacts are included.

Response: The *Resource Extraction* section addresses both surface and underground mining activities. The *Resource Extraction /Control Program and Concerns* subsection has been revised to discuss the regulatory controls on mill tailings piles provided by the Metallic Minerals Waste Management Act.

On Resource Extraction section Figure IV-1: Doesn't the Corps of Engineers regulate sand and gravel extraction in large rivers of interstate commerce? This is not reflected in Figure IV-1.

Response: The Corps of Engineers does regulate sand and gravel extraction in large rivers of interstate commerce under Section 404 of the Clean Water Act. Figure IV-1 (renamed as Table 6) reflects the Corps regulatory authority over sand and gravel extraction under the activity of regulating the discharge of dredge and fill material to the waters of the United States, including wetlands.

WATERSHED IMPLEMENTATION

MARK TWAIN WATERSHED PROJECT

What percent of the watershed is not adequately protected or exceeds acceptable erosion?

Response: USDA NRCS calculated that 54.3% of the watershed exceeds T.

Is the sediment being delivered to Mark Twain Lake exceeding the rate estimated for the reservoir design?

Response: Prior to the flood of 1993 sediment delivery was 25% of what was estimated. After 1993, shoreline erosion has caused increased lake turbidity due to loss of shoreline vegetative cover.

Is the sediment yield to the lake as predicted, but carrying more contaminants than expected?

Response: Contaminates levels are consistent with past years.

Is the project complete? Were Project goals met?

Response: Yes, the project is complete and some goals were marginally fulfilled while others exceeded what was agreed too. The overall project was considered to be a success.

FELLOWS-MCDANIEL LAKES WATERSHED

Under Watershed Implementation, Fellow/McDaniel Lakes Watershed, the project period is 1992 to 1997, and it states that this project is ongoing. To what extent have the goals and objectives been met?

Response: This section now includes a summary of the final report on this project.

JAMES RIVER/TABLEROCK LAKE WATERSHED PARTNERSHIP

Changed from:

Table Rock Lake was created in Southwest Missouri in the late 1950s. It is a popular recreational lake, drawing millions of visitors a year. The waters in this region have been historically known as high quality resources. Fishing for bass, crappie, and other game fish, boating, swimming, scuba diving, and other fresh water activities have been vital components to the area's economy. There have also been plans proposed recently to use Table Rock Lake as a drinking water source for the ever-growing community of Branson. The growth of the area is phenomenal and is continuing. Branson, although not in the James River Basin, relies on the quality of the area's lakes for its economic viability. Branson housed over 6,000,000 visitors in

1994. It is expected that this number will increase to over 10,000,000 by the year 2000. The James River is a major tributary to Table Rock Lake and has portions of the city of Springfield within its watershed.

To:

Table Rock Lake was created in Southwest Missouri in the late 1950s. It is a popular recreational lake, drawing millions of visitors a year. The waters in this region have been historically known as high quality resources. Fishing for bass, crappie, and other game fish, boating, swimming, scuba diving, and other fresh water activities have been vital components to the area's economy. The James River is a major tributary to Table Rock Lake and has portions of the City of Springfield within its watershed. Springfield withdraws drinking water from the James River in Greene County. The City of Branson recently completed a new drinking water treatment plant and intake on Lake Taneycomo just downstream of Table Rock Dam in close proximity to the intake that supplies drinking water to the College of the Ozarks. There have also been plans proposed recently to use Table Rock Lake directly as a drinking water source for the ever-growing community of Branson. The growth of the area is phenomenal and is continuing. Branson, although not in the James River Basin, relies on the quality of the area's lakes for its economic viability. Branson housed over 6,000,000 visitors in 1994. It is expected that this number will increase to over 10,000,000 by the year 2000.

Also, updated the project dates and amounts to reflect increases associated with this year's amendment.

SMITHVILLE LAKE WATERSHED PROJECT

In response to comments on the Smithville Lake Watershed project document, the paragraph describing populations served was edited as follows: (It is true that Kansas City does not receive water from the lake, but instead contributes water to Platte District #4, which also gets water from Smithville Lake. However, it was suggested that Kansas City would pull from Platte District #4 in the event of an emergency in the Kansas City water supply. Also, the 1998 inventory quoted by Hazardous Waste Program was not totally accurate. According to Kenny Duzan of the Public Drinking Water Program and Bill Hills in the Kansas City Regional Office, the lake serves more than just the three districts represented in the inventory.)

From:

Smithville Lake supplies drinking water for the cities of Smithville, Plattsburg, Edgerton, Trimble and four water districts with a total population served of 12,000. Kansas City occasionally pulls drinking water on an as-needed basis, also. The lake is heavily used for recreational purposes including camping, boating, fishing, skiing and swimming.

To:

Smithville Lake supplies drinking water for the cities of Smithville, Plattsburg, Edgerton, Trimble, Tracy and seven water districts serving over 15,000 residents. The lake is heavily used for recreational purposes including camping, boating, fishing, skiing and swimming.

TURKEY CREEK WATERSHED PROTECTION PROJECT

The second paragraph mentions objectives, one of which is to treat 75 percent of CRP ground released with no-till farming. Are we paying the landowner to no-till ground that we paid him for ten years to not farm?

Response: Sentence was revised. 319 funds are not being used as incentives for no-till.

On the map showing Special Area Land Treatment (SALT) and Earth Watershed Projects, Turkey Creek in Carroll County and Ray County is shown. Why is there duplicate efforts being funded by both Soil and Water Conservation Program tax money for a SALT project and 319 funding as shown in the Watershed Implementation section mentioned above?

Response: We have either SALT or EARTH projects in many of our 319 grant-funded watersheds. The 319 dollars currently require a 40% nonfederal match, and the S&WCP tax dollars fulfill this federal requirement.

The Table listing the SALT projects shows, unlike the map, that Turkey Creek project is in Ozark County. What is the correct location of the Turkey Creek SALT project?

Response: It's true, there is more than one Turkey Creek in Missouri and several have SALT projects. The 319 project is in Carroll and Ray counties.

AgNPS SALT PILOTS AND SALT WATERSHEDS

The Table listing the SALT projects indicates that the Clarence Watershed project emphasized preventing erosion, as the lakes were a threatened drinking water supply. As per the Inventory of Missouri Public Water Systems, 1998, Clarence now buys its water from Macon PWSD number 1.

Response: Your statement is correct and this information will be changed in the rulemaking proposal which should go through in 1999.

IMPLEMENTATION ASSISTANCE

Brief summaries of the 12 AgNPS SALT were added to the document as suggested (see revised draft, Watershed Implementation, Overview of SALT Pilots). Summaries for Concordia, Higginsville, Monroe City and the James River Partnership were not readily available and were not included. In speaking with Bob Ball, these summaries will be available on the MoWIN webpage in the near future.

WATERBODIES WITH PROBLEMS NOT QUITE SEVERE ENOUGH TO BE ON THE 303(d) LIST

The MCL of atrazine has over a 5000 fold safety factor within it. There is not a need for a list utilizing a de factor standard that is set arbitrary. This list does not match the 303(d) nor the additional monitoring list.

Response: 1) With respect to specific standards, the Missouri Water Quality Standards includes a value of 3 μg/l for atrazine in waters protected for drinking water supply. The NPSMP would not purport to unilaterally alter a state standard established through the formal rulemaking process.

2) The management plan addresses more public water supply reservoirs than are on Missouri's proposed 1998 303(d) list because the plan also addresses waters at risk of exceeding water quality standards.

3) This management plan is being produced concurrently with the development of the 1998 303(d) list. The final list will be incorporated into the NPS plan.

PUBLIC REVIEW DISTRIBUTION LIST

* American Fisheries Society
Conservation Federation of MO
* DNR-Air Pollution Control Program
* DNR-Division of Energy
* DNR-Division of Environmental Quality
* DNR-Division of Geology and Land Survey
* DNR-Environmental Services Program
* DNR-Hazardous Waste Program
* DNR-Jefferson City Regional Office
DNR-Kansas City Regional Office
* DNR-Land Reclamation Program
* DNR-Northeast Regional Office
* DNR-Public Drinking Water Program
* DNR-Soil and Water Conservation Program
* DNR-Solid Waste Management Program
DNR-Southeast Regional Office
* DNR-Southwest Regional Office
DNR-St. Louis Regional Office
DNR-Technical Assistance Program
* DNR-Water Pollution Control Program
* Esther Myers
* JD Information Services
Kansas City Water Services Dept.
Lincoln University Extension
* Mark Twain National Forest
* Metropolitan St. Louis Sewer District
Mid-America Dairymen Inc.
* MO Ag Industries Council, Inc.
* MO Attorney General's Office
MO Chamber of Commerce
* MO Corn Growers Association
* MO Dairy Association
* MO Department of Agriculture
* MO Department of Conservation
* MO Department of Health
* MO Farm Bureau Federation
* MO Pork Producers Association
MO River Communities Network
* MO Soybean Programs
Monsanto Co- Q2F
* Newman, Comley, Ruth
National Park Service
* Novartis Crop Protection
* REGFORM
Show-Me Clean Streams
Springfield City Utilities
* UMC Outreach and Extension
USDA-Farm Service Agency
* USDA-Natural Resources Conservation Service
* US EPA Region VII
* US Fish and Wildlife Service
* US Forest Service
* US Geological Survey

*Agencies/organizations that participated in review and/or workgroup meetings.

PUBLIC COMMENTS AND RESPONSES

Comments received during the first public review period (Feb. – Mar. 1999):

NPSMP GOALS AND OBJECTIVES:

The statement of Goals, Objectives and Measures of Success in the draft plan is weak and incomplete, and the Milestones section is not yet written. The lack of detailed goals and timetables means that this is <u>not yet</u> a management plan. It would be difficult to generate teamwork with all the other parties expected to participate in NPS management without a strong framework and set of timetables. The cooperation, coordination, and voluntary local effort called for in the Objectives all require a design for action that is not yet in place. The management plan should not be accepted until this failing is remedied.

Response: The NPS workgroup met several times after the first draft was released for public review in February 1999. The second draft for public review contains more explicit goals and objectives that reflect comments received and the input of the workgroup. The objectives list a time frame by which they are to be completed but the milestone schedule is not complete at this time (second review period, May 1999). The milestones are the objectives with more detail added regarding lead agencies. The workgroup will continue to work on the milestones during the second public review period and the final draft submitted to the Clean Water Commission will contain a complete milestone schedule.

Timing and resource availability are essential factors in achieving established goals. Our review of the "Goals for NPSMP" suggests that more time should have been allotted by some partners to attain the stated goals. Some of the activities scheduled to be completed by the year 2000, for example, will probably take longer. It is also unclear whether an assessment of available resources (people and money) has been made to support activities related to goal attainment.

Response: The strategic plans of other agencies are not within DNR's purview so I cannot respond to your statement regarding time allotted or resource assessment in order to attain goals. DNR's strategic plan was based on our best available assessment of resources we currently have and may have in the future.

We are uncertain as to whether adequate effort has been put forth to develop plausible solutions to identified problems or plan implementation strategies for goal achievement taking into consideration available resources. For example, the strategies listed by DNR for achieving the objective of a "complete statewide aquatic macroinvertebrate monitoring and statewide habitat assessment" do not identify what type of "research" is needed, the extent of "fish tissue sampling", how to "initiate monitoring on the Missouri and Mississippi Rivers" or how "special studies of habitat, fish communities" will be conducted. The "identification of watersheds which are most affected by

nonpoint source pollution" seems to be a paramount objective of a state nonpoint source management plan and one which should be given the highest priority. Sufficient resources may or may not be available to realize this objective in a timely manner. What resources are needed apparently has not been addressed in the Plan. As we all know, we must adequately define the problem and its causes before we can develop an acceptable solution and determine its cost. Does or will DNR have sufficient resources to meet this objective, is a valid question particularly since a nonpoint source management plan has been in effect since 1989 and this question (or objective) has not been completely answered.

Similar comments can be made with regard to other "partners" contributing to the development of what is hoped to be a viable and cost effective NPSMP for our state. Most all partners have stated admirable goals and objectives. They all know what they want to do or would like to do but exactly how to do it with available resources, in our opinion, has not been adequately addressed.

Response: The plan is not a detailed blueprint for nonpoint source management. Rather, it serves as a framework or compass leading us in the direction we want to head to address the problem. This framework has been supported and written by the partners who will be actively involved in implementing the plan. The details of how to implement strategies will be determined by the individual partners (lead agencies) in cooperation with other partners to ensure objectives are achieved.

It might make sense for the DNR to develop a relatively efficient process for bringing stakeholders together to discuss the various sources that may impact a given watershed and the various best management practices that may be helpful to reduce the extent to which nonpoint sources within the watershed are impacting the water quality. It might be helpful if the NPSMP included a description of a "generic" problem-solving process or decision making process for use by stakeholders within a given watershed so that each watershed doesn't have to "recreate the wheel." The "generic" problem-solving process or decision making process also could identify the extent to which the various state or federal governmental agencies would have information, human resources, or financial resources that could be accessed to support development of a voluntary water quality management plan for a watershed.

Response: DNR supports locally led and directed watershed initiatives and is very willing to provide information and support. In watersheds needing restoration where a watershed committee does not exist it may be necessary for DNR and other partners to help bring a group together. But a locally led, voluntary approach to watershed management is preferred. A "generic" problem-solving process that could be used by stakeholders is the development of a Watershed Restoration Action Strategy (WRAS). A WRAS is discussed in Section IV of the plan. A WRAS must be completed before Section 319 restoration money is awarded to grant recipients but it would be a good planning tool for any watershed group trying to determine strategies for restoration. DNR's Nonpoint Source Program will have guidance available on the development of a WRAS in the near future.

FUNDING

It is embarrassing that Missouri's "Maintenance of Effort" is zero under the provisions of the Water Quality Act because that was our average in 1986 and 1987. Couldn't we set a goal in this NPS plan that our funding should be maintained at or above the level requested by Governor Carnahan this year--$639,000? The program will need skilled staff to carry out the technical and interactive elements of the plan, and these require funds.

Response: Goal C, Objective 5 has been added and states: Maintain funding of NPS activities at or above 1999 levels.

NPS CATEGORIES

URBAN/SUBURBAN STORMWATER RUNOFF

Considering the Phase II impacts on our area of jurisdiction which will require NPDES permitting of stormwater discharges from storm sewers, some correlating mechanism in the NPSMP should be included to prevent duplicate control efforts. We believe the greatest pollution load to natural watercourses in our area from storm runoff enters through identifiable pipes, conduits or channels. A proper application of Phase II BMPs coupled with municipal cooperation within defined watersheds would do much to protect water quality in our area. The section of your NPSMP entitled "Urban/Suburban Stormwater Runoff" should address this relationship.

Response:

Comments received during the second public review period (May – June 1999):

NPSMP GOALS AND OBJECTIVES:

Goal A, Implementation strategy – Pursue a DNR budget expansion of 23 FTEs solely for water quality monitoring and water quality data management. Taken at face value, this seems to be an excessive number of new employees for this purpose.

Response: This was included to indicate the level of effort at least one partner is taking to help meet water quality goals. This measure has already been approved by the legislature so it will be removed from the strategies.

Goal B, Implementation strategy – Target support to Unified Watershed Assessment Category I watersheds for voluntary TMDL action plans or WQMP plan implementation. The Clean Water Action Plan stipulates that support will be targeted to priority watersheds identified by the Unified Watershed Assessment (UWA) and

other assessments. However, as stated in comments submitted during the public comment period, we have serious reservations concerning the UWA. Its utility for setting priorities is limited by virtue of the fact that 56 of Missouri's 66 watersheds are in Category I. Also EPA's unrealistic deadlines resulted in a rushed assessment based on inadequate data.

Response: This strategy was reworded to say: "Revise the UWA to make more usable and then target support…"

Goal B, Implementation strategy – Encourage the adoption of urban and suburban stream protection and stormwater sediment control resolutions and ordinances. Voluntary rather than regulatory measures should be encouraged.

Response: This strategy was reworded to say: "Advise local entities on the appropriate use of urban and suburban stream protection…"

Goal B, Evaluation measure – On a project-specific basis: tons of soil saved, nutrient applications reduced or prevented from leaving the field, reductions in pesticides applied, reductions in pesticides leaving the field. Reduced nutrient and pesticide applications may achieve reductions in losses from the field, but they should not be evaluation measures in and of themselves. Reduced application is only one alternative for managing nutrients and pesticides in runoff.

Response: The evaluation measure has been reworded to say: "On a project-specific bases, quantifiable measures such as: tons of soil saved, nutrients and pesticides prevented from leaving the field, reductions in nutrients and pesticides applied if appropriate."

Goal B, Evaluation measure – Number of Comprehensive Nutrient Management Plans (CNMP) implemented at animal feeding operations (AFOs). And Goal B, evaluation measure – Number of acres on which animal waste is applied in accordance with an approved CNMP. It seems premature to make CNMPs an evaluation measure. It is my understanding that CNMPs that meet the specifications set forth in the Unified National AFO strategy will not be available via public or private sources for at least one year and likely two or more. Moreover, proposed federal funding to provide technical assistance for CNMPs does not even come close to meeting cost projections for the program. I would suggest the number of acres under <u>voluntary nutrient management plans</u> as an alternative. If the number of CNMPs is included as an evaluation measure, then the number of acres on which waste is applied in accordance with an approved CNMP seems redundant because implementation of a CNMP infers application as prescribed by the plan.

Response: Evaluation measure was reworded to reflect "voluntary nutrient management plans" rather than CNMPs.

Goal B, Evaluation measure – Number of Stream Teams and volunteer monitoring teams. The number of stream teams and volunteer monitoring teams should not be an evaluation measure. The number of these teams does not correlate to nonpoint source impacts on water quality except perhaps in localized situations. Moreover, using volunteer programs as an evaluation measure raise the stakes for adding teams irrespective of the department's need for reliable monitored data collected by trained professionals.

Response: This evaluation measure is related to Goal B, Objective 3 and is one of many measures of information and education activities.

Goal C, Implementation strategy – Work with local authorities to achieve goals in the state NPSMP. Recommend adding "and landowners" after "local authorities."

Response: The additional language was added.

Pursuant to our discussion, please omit the Missouri Farm Bureau policy resolutions from Section IV. As I indicated to you, Betty Keehart had expressed interest in these resolutions, but it does not seem appropriate to me to include Missouri Farm Bureau with the six public entities identified in this section as "partner agencies." Also, some of these policy resolutions are not current because they were amended by voting delegates at our annual meeting last December, a process which occurs annually.

Response: As indicated on the Public Review/Distribution List, many entities, both public and private, have been actively involved in the development of this plan. Likewise, many entities, both public and private, will be involved in its implementation. The section referred to includes excerpts of strategic plans from only a portion of those entities. Unfortunately, this section reflects primarily the public agencies because those are the documents made available to us. We appreciate the involvement of Farm Bureau and the others in this process and look forward to working with them during implementation of the Plan. Farm Bureau's policy resolutions have been removed from the plan as requested.

GENERAL COMMENTS

Based on a quick review of the NPSMP, it is not clear if the DNR must devise management systems for all pollutants/sources (they are certainly all accounted for in the NPSMP) or if the DNR can selectively address the pollutants/sources associated with the most impairment. It is clear from the State Fact Sheet (1996) that point sources and nonpoint sources are contributing to the impairment of Missouri lakes, rivers, streams, and groundwater.

Response: The department, together with its partner agencies and groups, accepts as its mission to address all of the water quality issues in Missouri. To the extent that many problems stem from nonpoint sources, they will be addressed through the development and implementation of this plan. Where point sources are also involved the department

will address both types of sources to establish an equitable distribution of the work needed to reduce the pollutant load or otherwise eliminate pollution.

The NPSMP is intended to improve or restore water quality for the benefit of human health and the environment. But it is not clear how the DNR will address resources that can not be used for drinking water, swimming, or as a natural habitat due to natural causes. A river, stream, lake or groundwater that is "naturally" unusable (due to the natural existence of high salinity, high temp, natural chemical content, etc.) should not be considered "impaired." In this case, the DNR should not target the resource for "improvement."

Response: Some water resources are not usable for some purposes in their natural states. In general, neither the plan nor the department would strive to improve on nature. In some cases waters are recognized for failing to meet standards and are listed as impaired, although there may not be any remedy available for the situation other than a recognition that it exists. Examples include manganese released from sediments in lakes and low dissolved oxygen in slow flowing prairie streams during hot weather. In many of these cases the water quality standards, the yardsticks used to measure water quality, may be appropriately changed to address reasonable expectations for waters that do not otherwise rise to the levels that support typical uses, through no human cause.

The DNR reports that 100% of the lakes in Missouri have been surveyed. Of all pollutants listed in the "1996 State Fact Sheet," oxygen depleting substances and pesticides account for more than 98% of all pollutants know to cause impairment. Of all known sources, the agricultural industry and other natural influences contribute 93% of this pollution. Over 50% is contributed by the agricultural industry alone.

It is tempting to target this industry for further regulation, however, the oxygen depleting substances and pesticide levels may be due to seasonal weather patterns rather than the poor application of chemicals. Heavy rainfall in the spring can fill lakes with cropland runoff. Lakes with low turnover rates have little opportunity to recover quickly. Rivers and streams that can recover quickly have low levels of oxygen depleting substances and pesticides.

Response: With regard to oxygen depleting conditions, most Missouri lakes that suffer from this form of pollution do so because of materials that decompose, thus consuming oxygen, which are primarily introduced by human activity. Pesticides of concern in lakes are almost all synthetic compounds that are managed for crop production. While the management of lakes can take into account seasonal variations, turnover and other physical attributes and changes in the lake environment, it is clear that all of the materials can be managed in an environmentally protective manner, and the incidence of pollution is an indicator that that management can be improved.

The DNR reports that 41% of the rivers and streams in Missouri have been surveyed. Of all pollutants listed in the "1996 State Fact Sheet," Habitat Alterations and Siltation account for more than 97% of all pollutants know to cause impairment. Of all known

sources, the agricultural industry, hydro-modification, channelization, and other natural influences contribute over 98% of this pollution.

Channelization by its operation, can also cause hydro-modification and the natural influences that are listed as sources. Because of this, channelization is probably the cause of over 60% of impairment in Missouri rivers and streams. It is not clear how the DNR can reverse the affects of channelization.

Response: Channelization is addressed either actively or passively. The best example of active intervention is the restoration of the Kissimmee River in Florida, in which cut off channels are being rehabilitated to carry flow once again, adjacent wetlands are restored to vigorous conditions, and the old constructed channels are isolated and abandoned. Passive restoration, which obviously takes more time, allows the stream or river to use its energy to re-establish a typical channel, provided that flow regimes and buffer areas are provided.

Assuming that "big river" data is not dominating the results found in the "1996 State Fact Sheet," the greatest benefit to Missouri lakes, rivers, streams, and groundwater could come from the continued study of these systems and their interactions with nonpoint sources. The study would help the planners of civil engineering projects and farmers decide how to lessen the negative impacts to Missouri's natural resources. The fact sheet is clear that point sources are not contributing to the impairment of lakes, rivers, streams, and groundwater. Assuming that altering the affects of channelization in the short term is not practical and that pesticides and fertilizers are applied properly, the NPSMP should give the greatest amount of attention to the continued study and monitoring of aquatic biology and the monitoring of existing lakes, rivers, streams and groundwater.

Response: Monitoring will be emphasized in future work of the department, but not to the exclusion by any means of restoration work where that is possible.

APPENDIX C

Legal Certification

LEGAL CERTIFICATION

The WQA of 1987 requires:

> "A certification by the attorney general of the State or States (or the chief attorney of any State water pollution control agency which has independent legal counsel) that the laws of the State or States, as the case may be, provide adequate authority to implement such management program or, if there is not adequate authority, a list of such additional authorities as will be necessary to implement such management program and a schedule and commitment by the State or States to seek such additional authorities as expeditiously as practicable."

Preparation of the Nonpoint Source Assessment and Management Plan is the responsibility of the Department of Natural Resources as defined in Missouri's Clean Water Law, RSMo 644:

644.021-1. There is hereby created a water contaminant control agency to be known as the "Clean Water Commission of the State of Missouri," whose domicile for the purposes of sections 644.006 to 644.141 shall be deemed to be that of the department of natural resources...

***

644.136. The commission is hereby designated as the water pollution agency for the state for purposes of any federal water pollution control act and may

(1) Take all necessary or appropriate action to obtain for the state the benefit of any federal act, or to obtain federal approval of any state water pollution control program;

(2) Apply for and receive federal funds made available under any federal act;

(3) Approve projects for which loans or grants under any federal act are made to any municipality or agency of the state;

(4) Participate through its authorized representatives in proceedings under any federal act;

(5)Recommend measures for reduction of water contamination originating within the state; and

(6) Recommend to the governor for his designation any areas of the state which require special action under sections 644.006 to 644.141 or any federal water pollution control act. The governor shall hereby be authorized, as provided in section 644.141 to so designate such areas and establish local agencies or authorities as required by any federal water pollution control act to carry out the planning and operation for such areas required by any federal water pollution control act.

Text reproductions of the original letters.

M E M O R A N D U M

TO: Ed Knight

FROM: William Bryan

DATE: June 23, 1999

RE: *NPS Management Plan*

You have requested our certification that state law provides adequate legal authority for the Department to implement this plan as required by the WQA of 1987. Upon review of the draft plan, it is my opinion that state law provides adequate authority for the Department to implement the draft plan.

This certification does not extend beyond the precise question and answer articulated above. As you know, we are involved in litigation over the Commission's authority to entertain third-party permit appeals and we express no opinion as to how this ongoing litigation may affect the Department's authority to implement the plan, or if it will have any effect at all.

Please let me know if you have any questions.

WJB
c: Michael Warrick

APPENDIX D

Consistency Review

CONSISTENCY REVIEW

Section 319 of the Clean Water Act requires states to review federal assistance programs and development projects for consistency with their nonpoint source management programs (NPS). The Act requires each state to identify those federal programs and projects it will review for consistency and also requires the respective federal agencies to accommodate the identified concerns according to Executive Order 12372. This is not a new provision, as existing legislation requires federal agency compliance with all federal, state, interstate, and local pollution control requirements. The law directed federal agencies to modify their regulations within 60 days to allow state review of individual applications and also requires agencies to accommodate state concerns about consistency.

In August 1998 EPA proposed federal guidelines for implementation of Section 319 consistency provisions. This section may be amended to address requirements of the final rule. In addition, several court decisions have interpreted some decisions regarding implementation of section 401 of the Clean Water Act. Some of those lawsuits are currently under appeal and this section may be revised to be consistent with the final decisions in those cases.

Many of the procedures and mechanisms for ensuring consistency of federal programs with the state's NPS activities already exist at the state level. These include the State Clearinghouse administered by the Office of Administration (OA) and the National Environmental Policy Act (NEPA), which mandates the environmental assessment (EA)/environmental impact statement (EIS) process. The success of the review process will depend on the ability of the state and the federal agency involved to work cooperatively to resolve any conflicts. In addition to major federal actions, which are subject to these procedures, other federal permit and license procedures also include provisions through which consistency with the nonpoint source management plan may be accomplished.

To ensure early notification and effective communication to accomplish the consistency review process and achieve its clean water goals, the Missouri Department of Natural Resources (the department) will work with OA and through the NEPA process. Furthermore, the department will coordinate with the federal agencies that administer federal permit and licensing programs to ensure consistency. Additionally, development of Watershed Management Plans and Watershed Restoration Action Strategies in the state will provide an opportunity for addressing consistent nonpoint source remedial and funding activities on federal lands.

Specific federal assistance programs that will be reviewed by the state for plan consistencies include changes to USDA assistance programs including EQIP and conservation practice specifications, and the development of the USFS master plan. For USDA programs and practices, the nonpoint source staff will use their participation in the State Technical Committee to review and offer comments on changes as they are proposed and discussed. The Mark Twain National Forest is presently conducting

background work in anticipation of the major update of the forest plan in 2005, and this work includes water quality studies related to forest practices. These studies have involved the review of Department of Natural Resources staff. Furthermore, the department and other agencies are paying special attention to intensive forest harvesting practices that may be related to large chip mills that have begun operation in the state in the past several years. In addition to dealing with new programs or practices that emerge during the period of this plan, the nonpoint source staff may review existing program elements for consistency with this plan in a manner similar to the process described below for the review of federal land management practices.

The federal government owns and manages significant land areas within the state of Missouri. The state will work cooperatively with the federal agencies responsible for these lands to assure they are managed in compliance with the provisions of this plan. Below are items to be undertaken by the state (provided funds are available) to assure compliance on federal lands.

1. Provide a copy of this plan, as approved or revised, to the director of each agency managing federal lands in Missouri by the end of each fiscal year.
2. Develop (and maintain) a compliance checklist for review of federally managed lands by the end of 2000.
3. Visit with the land manager for each agency (or closer contact if appropriate) to review provisions of the program and the checklist during the period 2001 to 2004.
4. Cooperatively develop an action plan for any inconsistencies or noncompliance issues during the period 2001 to 2004.
5. Issue reports documenting these reviews and any actions taken, as each are completed.
6. Notify EPA of any unresolved issues following the above reviews, as identified.

Following is a listing of federal assistance and development projects, and permit or licensure activities that are subject to review for consistency with the nonpoint source management plan. Discussions of some of the programs administered by these agencies, and how their potential impacts may be managed through consistency review, follow the listing.

Department of Agriculture
- Forest Service
  - Forest Management Plans
  - Timber Harvest Permits
  - Grazing Permits
  - Research Management Plans
  - State and Private Management Plans
  - Recreation Plans

- Natural Resources Conservation Service
    - Conservation Reserve Program
    - Environmental Quality Incentives Program
    - Wetland Reserve Program
    - Conservation Compliance
    - Farmland Protection Program
    - Wildlife Habitat Incentives Program
    - Emergency Watershed Protection Program
    - Conservation Farm Option
    - Resource Conservation and Development Program
    - Forestry Incentives Program
- Rural Development Agency
    - Rural Housing Loans and Grants
    - Home Ownership Loans
    - Guaranteed Rural Housing Loans
    - Home Repair Loans and Grants
    - Rural Rental Housing Program
    - Rural Housing Site Loans
    - Self Help Technical Assistance Grants
    - Farm Labor Housing Loans and Grants
    - Housing Preservation Grant Program
    - Business and Industry Guaranteed Loans and Direct Loans
    - Commercial Facilities Direct Loans, Guaranteed Loans and Grants
    - Fire and Rescue Loans
    - Intermediary Relending Program
    - Rural Business Enterprise Grants
    - Rural Cooperative Development Grants
    - Solid Waste Management Grants
    - Technical Assistance and Training Grants
    - Water and Waste Disposal Loans and Grants
    - Rural Economic Development Loans and Grants

Department of the Interior

- Bureau of Land Management
    - Watershed Projects
    - Mineral Exploration and Development
    - Coal, Oil and Gas Leasing
    - Coal Reclamation
    - ORV Activities
    - Timber Activities
    - Grazing Allotment/Grazing Management/Permit Issuance
    - Chemical Pesticides
    - Area Analysis/Cumulative Impacts
    - Wetlands protection
    - Riparian Management Plans
    - Hydrologic Modification
    - Transportation Plans

ACEC Plans
Bureau of Reclamation
Irrigation Development
Fish and Wildlife Service
Management of National Wildlife Refuges and proposed acquisitions
National Park Service
National Park Management and proposed acquisitions
Wildlife Management
Grazing Management
Abandoned Mines Management
Federal Energy Regulatory Commission
Dam relicensing
Department of Defense
Natural Resource Management Plans and Projects
Military Construction Projects
Facilities Development Plans and Projects
Land and Water Based Military Training Plans and Exercises
Plans and Projects to Reduce Specific Nonpoint Source Problems
Projects under the Defense Environmental Restoration Program
Dams or Flood Control Works
Ice Management Practices
Land Acquisition for Spoil Disposal or Other Purposes
Selection of Open Water Disposal Sites
Department of Transportation
Federal Highways Administration
Highway Construction/reconstruction
ISTEA
Federal Aviation Administration
Location, design, construction, maintenance and demolition of federal aids to air navigation
Airport and Tarmac Runoff

Department of Defense, U.S. Corps of Engineers
The U.S. Army Corps of Engineers is the federal government's largest water resources development agency. At the direction of Congress the Corps of Engineers becomes involved in varied missions including improving river navigation, reducing flood damage, and controlling beach erosion. The Corps also generates hydropower, supplies water to cities and industry, regulates development in navigable water, and manages a recreation program. Most of the surface waters in the U.S. are stored or moved through Corps of Engineers water control projects (dams, levee systems, and navigation projects). In total, nearly 2,000 water resources projects have been placed under the responsibility of the Corps of Engineers through authorities such as the Flood Control Act, The River and Harbor Act, and the Water Resources Development Act.

The Corps of Engineers authority to manage water quality is founded in the Federal Water Pollution Control Act of 1948 and its amendments, including the Clean Water Act

of 1977 and the Water Quality Act of 1987. Executive order 12088, Federal Compliance with Pollution Control Standards, also required compliance by Federal facilities and activities with applicable pollution control standards in the same manner as any non-Federal entity. To ensure project compliance, the Federal Facilities Compliance Act of 1990 provides for EPA and or states to inspect federally owned or federally operated facilities that are subject to the Clean Water Act of 1977.

For new projects, the regulations call for necessary studies and evaluations to be conducted during the engineering and design phase to ensure that the completed projects will be managed with clear objectives connected to water quality. These studies are to include watershed based evaluations of the "preproject" aquatic ecosystem, and evaluations of the physical, chemical, and biological factors that are likely to be influenced by the proposed project. These studies are also to include identification of watershed-based tools and practices that will achieve water quality standards and maintain the aquatic ecosystem in a sustainable manner once the proposed project is completed.

Department of Interior, Bureau of Reclamation

Missouri is within the Great Plains Region of the Bureau of Reclamation, headquartered in Billings, Montana with an area office in Grand Island, Nebraska. The USBR is involved in the management of water related resources west of the Mississippi River. Besides being the largest wholesale supplier of water in the United States, the USBR is the second largest hydroelectric power generator. The mission of the USBR is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. One of the ways this mission is accomplished is by encouraging all that receive Reclamation water to use it wisely at the outset. However, coordination among other associated agencies is also highly valued. The USBR Environmental and Planning Coordination Office serves as principal advisor to the Office of Policy for environmental compliance and resources planning under the National Environmental Policy Act (NEPA), Endangered Species Act, Fish and Wildlife Coordination Act, Clean Water Act, Clean Air Act, legislation related to hazardous waste, pest management and invasive species, Natural Resource Damage and Restoration, and related environmental legislation, rules, and regulations, as well as, the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies .

The USBR revised nearly all their environmental policy between 1994 and 2002. Areas of coordination and administration include: hazardous waste and materials management, floodplain management, dam operation, wetland mitigation, Cultural Resources; as well as activities under the Endangered Species Act and NEPA. The purpose of this effort is to build environmental values into the agency-wide operations of the Bureau of Reclamation.

Department of Interior, Bureau of Land Management

The Bureau of Land Management (BLM) administers its program for livestock grazing on the federal lands administered by BLM through the BLM Grazing Regulations. These

regulations authorize BLM to issue grazing permits for ten-year periods, provide guidance for the required development of state or regional standards and guidelines, and set forth criteria and management practices to achieve healthy rangelands. These standards and guidelines are to be applied through permits to ensure that the following fundamentals of rangeland health are achieved:

1. Watersheds are in, or making significant progress toward, properly functioning condition.
2. Ecological processes are maintained or there is significant progress toward their attainment.
3. Water quality complies with state water quality standards.
4. Habitats are, or are making significant progress toward being restored or maintained for threatened or endangered species.

In addition, the Bureau of Land Management also administers the extraction of mineral resources from federal lands.

Department of Transportation
Department of Transportation (DOT) Environmental Policy - DOT has developed a multi-level policy to include full involvement of partnerships, complete integration of environmental concerns, and active protection and enhancement of the environment. A key element of this policy addresses protection and enhancement of the environment and makes the commitment that the Federal Highway Administration will avoid, minimize and mitigate adverse effects of transportation projects on social and natural resources; implement innovative enhancement measures; participate in funding mitigation and enhancement activities; and ensure that transportation enhancement funding provided under ISTEA is used to maximize environmental benefits.

Federal Highway Administration (FHWA) Erosion and Sediment Control Policy - it is the policy of the FHWA that highways shall be located, designed, constructed and operated according to standards that will minimize erosion and sediment damage to the highway and adjacent properties and abate pollution of surface and ground water resources.

The Nonpoint Source Control Branch is in partnership with FHWA to develop and conduct an erosion and sediment control training course for State DOT offices and local governmental transportation officials and road crews.

Department of Agriculture
Farm Services Agency - FSA - Emergency Agricultural Conservation Program (ACP) -- The ACP program provides cost-share assistance to farmers for construction of a variety of soil and water conservation and agricultural pollution abatement practices. Practices can include pasture establishment, conservation tillage, winter cover-crop usage, terrace installation, fencing, surface drains, soil waterways, animal waste facilities, vegetative barriers and contour farming. Use of funds for practices that drain wetlands has been forbidden since the issuance of Executive Order 1190 in 1977.

NRCS - Farmland Protection Program
NRCS - Wetland Reserve Program
NRCS - Plant Materials Center (PMC) Program
NRCS - Grazing Incentive Program (GIP)

Rural Economic and Community Development - Watershed Protection and Flood Prevention Loans-- nonprofit, sponsoring local organizations in authorized watershed areas are eligible for cost sharing under this program. The project funds improvements such as flood prevention, irrigation, drainage, water quality management, sedimentation control, fish and wildlife development, public water based recreation, and water storage.

Rural Economic and Community Development - Resource Conservation and Development (RC&D) Loan Program -- Direct loans provided to public agencies and local nonprofit corporation in authorized RC&D areas for the purpose of developing community or public outdoor-oriented, water-based recreational facilities.

NRCS - Watershed Protection and Flood Prevention (Small Watershed Program: PL83-566 Program) -- This program provides technical and financial assistance for planning, designing and installing watershed improvement projects. Its purpose is to help protect, develop and utilize land and water resources in small watersheds. State agencies, counties (single or groups), municipalities, towns, Soil and Water Conservation Districts, flood prevention/control districts, or any other nonprofit organization authorized by State law to manage watershed projects are eligible for assistance. Emphasis is now placed on nonstructural protection practices.

NRCS -- Emergency Watershed Program -- The principal soil and water conservation technical assistance program of NRCS with assistance provided to plan a variety of soil and water conservation practices and structures, many of which are cost-shared under the FSA Agricultural Conservation Program.

NRCS Resource Conservation and Development -- program provides grants and advisory services for preparation and execution of long-range plans for flood prevention, sediment-erosion control, public water-based recreation, fish and wildlife developments, agricultural water management and control and abatement of agriculture pollution.

Department of Agriculture, Forest Service
The Mark Twain National Forest (MTNF) is 1,494,217 acres in size. The MTNF administers its programs for recreation, wilderness, wildlife, fisheries, timber, range, roads, minerals, fire, soil, water, and air. All natural resource management is guided by the MTNF Land and Resource Management Plan. Management direction includes goals, objectives, forest-wide standards and guidelines, management prescriptions with their specific standards and guidelines, and delineations of the management areas. Management direction is responsive to the requirements of the National Forest Management Act of 1976. The forest plan considers the environmental effects of forest management, including water quality impacts. The MTNF maintains standards and guidelines in the MTNF Forest Plan that pertains to water quality.

APPENDIX E

Nonpoint Source Categories

Agriculture
Silviculture
Construction
Urban/Suburban Stormwater Runoff
Resource Extraction
Stowage and Land Disposal of Wastes
Hydrologic/Habitat Modification
Other

AGRICULTURE

CROP PRODUCTION

Characterization

Crop production is particularly important to Missouri's economy. In 1992, from over 12 million acres of harvested cropland (Bureau of the Census, 1992) total production of principal crops was valued at $2.5 billion (Missouri Farm Facts, 1994). http://agebb.missouri.edu/mass/farmfact
Acres devoted to production, in descending order, were: soybeans, 4.2 million; hay, 3.5 million; corn for grain, 2.4 million; wheat for grain, 1.3 million; sorghum for grain, 0.6 million; and cotton, 0.3 million (Bureau of the Census, 1992).
In 1997, acres devoted to production, in descending order were: soybeans, 4.7 million; hay, 3.7 million; corn for grain, 2.4 million; wheat for grain, 1.0 million; and sorghum for grain, 0.3 million (Bureau of Census, 1997). A large, but decreasing amount of this production is occurring on highly eroding croplands.

Commercial fertilizers were applied in Missouri to 9.7 million acres in 1992. Amounts applied are not readily available; the nearest approximation is 1.8 million tons shipped for use in Missouri (Missouri Fertilizer Tonnage Report, 1994). Insecticides were used on 1.8 million acres of crop and hayland; herbicides on 6.7 million (Bureau of the Census, 1994). Missouri ranked tenth in the nation in commercial fertilizer as an expense for farm production costs in 1997 with 3.6 percent of the U.S. total. http://www.nass.usda.gov/census/cnesus97/ranking/ac97s-3r.pdf

In a survey conducted by the University of Missouri in 1992, producers of soybeans, corn, wheat and sorghum reported herbicides were applied to over 95 percent of all grain crop acreage except wheat, of which only 8 percent was treated. Herbicides accounted for 95 percent of the 13.4 million pounds of pesticide active ingredients applied (Becker et al., 1992).

(More recent production statistics are available for Missouri; however, the 1992 figures are useful for state to state comparisons of amounts of commodities produced and inputs used for production). The 1997 Bureau of Census survey can be read online at:
http://www.nass.usda.gov/census/census97/volume1/mo-25/toc97.htm

2001 Missouri Crop Summary

All Crop Summary Tables

Missouri farmers produced more soybeans, cotton, rice, potatoes, tobacco and hay in 2001 than a year earlier. Crops that declined in production from the previous year included corn, sorghum, winter wheat and oats. Wet weather occurred periodically during the spring planting season but farmers managed to plant most of the acreage intended for crops. Corn planting finished a few days ahead of average but single-crop soybean planting was extended into early July, slightly behind schedule. The above normal rainfall of May, June and July built some moisture reserves which helped sustain crop development through the drier months of August and September. The fall harvest had normal interruptions from rain but most farmers had completed their row crop harvesting by mid-November.

Soybeans: Production in 2001 totaled 186 million bushels, up 6 percent from the 2000 crop, and 27 percent above the 1999 production. Farmers in Missouri harvested 4.90 million of the 4.95 million acres planted in the State. Missouri yields averaged 38 bushels per acre, 3 bushels above the 2000 yield and equaling the record high set in 1992 and 1994. Nationally, Missouri ranks fifth in harvested acres (tied with Nebraska) and seventh in production. The State production is valued at $786 million, 1 percent less than the 2000 crop.
Corn: Production during 2001 totaled 346 million bushels, 13 percent below the record high of a year earlier, but 40 percent more than the low 1999 production. Yields for the State averaged 133 bushels per acre, down 10 bushels from the record high of 2000 but 36 bushels above 2 years ago. Out of 2.70 million planted acres, corn for grain was produced from 2.60 million acres and silage was cut on 70,000 acres. The total value of grain production was estimated at $664 million, 6 percent less than the 2000 crop. Silage yields averaged 16 tons per acre, up 1 ton from a year earlier. Silage production totaled 1.12 million tons, 24 percent above 2000.
Winter Wheat: Production in 2001 totaled 41.0 million bushels, down 17 percent from a year earlier. Of the 900,000 planted acres, farmers harvested 760,000 acres for grain. Missouri yields averaged 54 bushels per acre, 2 bushels above 2000, and equaling the record of 1997. Value of the crop is estimated at $98.9 million, 12 percent less than the 2000 crop.
Grain Sorghum: Grain sorghum production totaled 20.7 million bushels, 17 percent less than in 2000. Of the 230,000 acres planted, 220,000 were harvested for grain, the lowest grain acreage since 1969. Average yield for the State was 94 bushels per acre, 2 bushels above the 2000 yield and the second highest on record. Grain production was valued at $40.7 million, 7 percent less than 2000. Sorghum silage yields averaged 8 tons per acre, 1 ton above the previous year.
Cotton: Production is estimated at a record 695,000 bales, 29 percent more than in 2000. During the first year of the boll weevil eradications program, the State yield, at 834 pounds, is 166 pounds above a year earlier and the second highest on record. Missouri farmers harvested 400,000 of the 405,000 acres planted. Value of the lint is estimated at $103 million, down 29 percent from a year earlier. Cottonseed production totaled 268,000 tons, 31 percent more than the previous year, while the value of cottonseed, at $23.0 million, increased 24 percent.
Rice: Production during 2001 totaled a record high 12.3 million cwt, up 28 percent from a year earlier. The record high 207,000 acres harvested produced a State record yield of 5,950 pounds, 250 pounds above the 2000 average yield. Value of the crop is estimated at $48.7 million, down 6 percent from a year earlier, as the average value per cwt. dropped 27 percent from the previous year.
Tobacco: Production in the State totaled 3.08 million pounds, 4 percent more than in 2000. The State yield of 2,370 pounds is 250 pounds higher than a year earlier. Missouri farmers harvested 1,400 acres of tobacco, which along with the previous year's level, is the lowest since records began in 1866. The tobacco crop is valued at $5.84 million, up 6 percent from the 2000 crop.
Potatoes: Production for 2001 totaled 1.90 million cwt, 13 percent above the 2000 production. The 5,600 acres harvested produced a record yield of 340 cwt, up 65 cwt from the 2000 yield. The value of the crop is estimated at $9.71 million, 4 percent more that the 2000 crop.
Hay: Production of all hay totaled a record 7.85 million tons, up 18 percent from 2000. The average yield for all hay at 1.94 tons was up from 1.79 tons a year earlier. Acres of Alfalfa hay were estimated at 450,000, down 4 percent from 2000. Alfalfa yields averaged 3.05 tons, 0.05 ton below a year ago, while production declined 6 percent to 1.37 million tons. Acres of all other hay increased 11 percent to 3.60 million. Yields for other hay averaged 1.80 tons, up 0.2 ton, while production increased 25 percent to a record 6.48 million tons.

Oats: Production in 2001 totaled 1.0 million bushels, 37 percent less than the 2000 crop. Of the 40,000 planted acres, 20,000 were harvested for grain. State oat yields averaged 50 bushels, down 3 bushels from last year. Value of the crop is estimated at $1.60 million, 33 percent less than in 2000.
(Missouri Agricultural Statistics Service, Missouri Farm Facts)

Nonpoint Source Impacts

Sediment

Missouri's 1998 Water Quality Report, lists 7,601 miles of classified streams as not fully attaining designated beneficial uses due to siltation, while the 2002 Water Quality Report (DNR, in publication), reports a total of 7,741 miles or 35% of all classified stream miles as not fully attaining designated beneficial uses.

Cropland sheet and rill erosion are only partly responsible for sediment impacts to in-stream habitat with much coming from gullies and stream banks. However, erosion control practices are an important segment of appropriate best management practices with benefits for both soil conservation and prevention of movement of some pesticides and nutrients.

High rates of erosion can cause serious production problems on affected farmland. On some Missouri soils, five tons of soil erosion per acre per year is considered to be "tolerable". This rate is indicated by "T" in soil loss tables. Yet, under natural conditions, it can take 300 or more years to form one inch of soil. At the five-ton rate, it takes only 33 years to lose that inch. Typically, cropland soils can potentially be eroded significantly faster than new soil can be formed.

The National Resources Inventory (December 2000) estimated that in 1982, Missouri contained 13 million acres of cultivated cropland with an average Universal Soil Loss Equation (USLE) rate of 10.9 tons per acre per year. However, in 1997 that erosion rate decreased to 5.6 tons per acre per year on 10.5 million acres of cultivated cropland.

Table 2

Sheet and Rill Erosion on Cultivated Cropland In Missouri between 1982-1997	1982	1987	1992	1997
Acres of Cultivated Cropland	13,121,300	12,647,000	10,991,100	10,513,300
Average USLE Soil Loss Rate On Cultivated Cropland	10.9	8.4	6.6	5.6
Total Soil Loss On Cultivated Cropland (total tons)	142,649,800	105,754,100	72,259,400	59,097,100
Acres of Cultivated Cropland Eroding Above "T"	7,214,100	6,152,100	4,572,800	3,934,400
Average USLE Soil Loss Rate On Cultivated Cropland Eroding Above "T" (tons/acre/year)	17.4	14.7	12.2	11.0
Total Soil Loss On Cultivated Cropland Eroding Above "T" (total tons)	125,677,000	90,194,600	56,003,800	43,274,300

Additionally, trend analyses of water quality monitoring data from the last thirty years on the Missouri River at St. Louis and for the last twenty years on the Mississippi River at Alton and at Thebes, Illinois, all show a decline in suspended solids over time. (DNR, unpublished). Clearly, soil conservation programs which rely on government cost-sharing and other financial incentives are working to reduce sediment delivery to streams.

Nutrients

The need for nutrient applications is unquestionable; harvest of crops removes significant amounts of nutrients from the soil, preventing their recycling. Sources are primarily commercial fertilizers, animal manure and nitrogen-fixing legumes used as a part of crop rotations. However, nutrients leaving the field have the potential to become pollutants. In aquatic systems, growth of algae and other aquatic plants in response to nutrient input varies with light availability. In southern Missouri's clear Ozark streams and lakes, nutrients such as phosphorus and nitrogen can lead to increased aquatic plant growth. However, in northern Missouri where water bodies are less clear due to high mineral turbidity, growth of algae is restricted by the

limited penetration of light availability. Nevertheless, high nutrient concentration remains a threat to streams and reservoirs. Recently, EPA changed their interpretation of the "threatened" category and now considers it to mean that the water is impaired or will be within the next 2 years. Therefore, the Missouri Department of Natural Resources has removed it from their assessment database. Officially this change will not be shown in any department lists or publications until the 2004 305b report. (John Ford, MDNR)

Another potential threat to Missouri’s drinking water reservoirs stems from nutrient enrichment enhancing algal blooms which, in turn, provide the precursors that react with chlorine (the primary drinking water disinfectant) to form disinfection byproducts (DBPs). The primary DBPs are trihalomethanes and haloacetic acids. Based on monitoring data at all of Missouri’s surface water supplies during 1996, about 60% of them would have difficulty meeting EPA’s proposed maximum contaminant level of 0.80 mg/L for trihalomethanes.

Nitrate occurs naturally in ground water, even under pristine conditions. Scientists generally concur that nitrate as nitrogen in ground water at concentrations above 1 mg/L is caused by human activity, although under certain conditions, the natural concentration can be higher. Concentrations of more than 10 mg/L in drinking water can cause adverse health effects in humans, most notably infants under six months of age, and in young livestock. Nitrate toxicity, or methemoglobinemia (blue baby disease), results because the blood’s ability to absorb oxygen is reduced. Further, according to a study by authors from the National Cancer Institute, University of Nebraska and Johns Hopkins University, long-term exposure to elevated nitrate levels may contribute to the risk for non-Hodgkin’s lymphoma (Ward, et al., 1996).

Potential nonpoint or human-induced sources for nitrate in ground water include improper well construction, feedlots, chemical mix sites and on-site sewage disposal systems such as septic tank drain fields or leaking lagoons. The available data on nitrate contamination of ground water attributable to either point or nonpoint sources indicate that it is locale-specific because so many interacting factors are involved. The occurrence and distribution of nitrate, as nitrogen, and selected pesticides in ground water in Missouri was determined using data collected between 1986 and 1994 from 854 domestic wells and 38 springs. Sampling sites were located in 81 of the 114 counties in Missouri. Hydrogeologic, well, agricultural-practice and land-use data were used in statistical analyses to determine relations to nitrate concentrations and pesticide detection frequency in ground water. More than 36 percent of the sites had nitrate concentrations in excess of 3 milligrams per liter, indicative of a possible human-related source for many sites. Almost 18 percent of the sites had (at least one sample with) nitrate concentrations equal to or in excess of the Missouri drinking-water supply criterion of 10 milligrams per liter (US Geological Survey, 1996).

Elevated nitrate concentrations in ground water were significantly related to aquifer, well depth, well diameter, water-level depth below the land surface, well distance to a feed lot, and well distance from a chemical mixing area. (A chemical mixing area refers to an area where any kind of agricultural chemical, either fertilizer or pesticide, was mixed.) Ground water from glacial drift or Pennsylvanian rocks had significantly higher concentrations of nitrate than did ground water from alluvial, Mississippian/Springfield Plateau, or Cambrian-Ordovician/Ozark aquifers. Water samples from wells less than 75 feet deep, greater than 6 inches in diameter, and where

the water level was less than 50 feet from the land surface had significantly higher nitrate concentrations than samples from other wells. Water samples from wells less than 0.25 mile from a feedlot and wells where chemicals were mixed within 100 feet of the well had significantly higher nitrate concentrations than samples from other wells (US Geological Survey, 1996).

Pesticides

Increasing environmental concerns, technological developments, increased costs of inputs and changing soil conservation measures have brought about significant changes and trade-offs in farming practices in Missouri. As effective, relatively inexpensive herbicides were developed, producers adopted their use as an alternative to extra cultivation. With widespread use, however, the herbicides began appearing in water bodies. Of particular importance in Missouri is the presence of atrazine and other herbicides in reservoirs used for drinking water. Passage of the Safe Drinking Water Act, which eventually limits the levels of certain contaminants in drinking water, including atrazine, has brought the issue to the forefront. Lakes are particularly at risk because of retention time; late spring runoff events generally carry a flush of recently applied pesticides, which may move slowly through the system. Or, in the case of drinking water reservoirs, the spring flush may be held for use throughout the remainder of the year. In 2003, over half (55/96) of the surface drinking water supplies had measurable levels of pesticides in the finished water.

Nationally, use of conservation tillage increased annually in the early 1990's, but between 1998 and 2002, conservation tillage decreased over 6 million acres. Conservation tillage practices (no-till, mulch-till, and ridge-till) leave 30 percent or more crop residue on the soil surface decreasing soil erosion, increasing moisture infiltration, reducing farmers' fuel consumption, adding organic matter and increasing tilth. Missouri has followed the national trend of reduction in the use of conservation tillage starting in 1998 from 5.5 million acres through 2002 at 3.9 million acres (Conservation Technology Information Center, 2002).
http://www.ctic.purdue.edu/Core4/CT/CT.html

Conservation tillage requires trade-offs; increased use of pesticides, particularly herbicides, is frequently necessary. From 1989 to 1992 there was a three-fold increase in the amount of the nonspecific, "burndown" herbicide glyphosate used (Becker, et al., 1992). Also, with increased moisture infiltration comes a greater risk of ground water contamination from percolating nutrients and pesticides.
(Atrazine BMP's and Alternatives in Missouri UMC Publication 4851, 1996)
http://muextension.missouri.edu/xplor/agguides/crops/g04851.htm

In the study cited above (US Geological Survey, 1996), pesticides were detected in ground water much less frequently than nitrate, and at much lower concentrations. Concentrations of at least one pesticide exceeded the maximum contaminant level or health advisory limit in 1.9 percent of samples. Atrazine, the most widely used herbicide, was the most frequently detected pesticide in the small number of detections.

Pesticide detections in groundwater samples were significantly related to aquifer, well depth, well diameter, water-level depth below land surface, distance from well to a chemical mixing

area, and nitrate concentrations. Water samples from wells less than 75 feet deep, greater than 6 inches in diameter, and where the water level was within 50 feet of the land surface were more prone to pesticide detections than samples from other wells. Water samples from wells where chemicals were mixed less than 100 feet from the well were 3.4 times more likely to have a pesticide detection than water from wells where pesticides were mixed at distances greater than 0.25 mile from the well. Ground water in areas susceptible to elevated pesticide concentrations also had significantly higher nitrate concentrations. The data indicate the presence of elevated nitrate and pesticide concentrations in ground water within the State, although they primarily are associated with practices that occur near the wellhead, are likely to be localized and limited to shallow ground water (US Geological Survey, 1996).

Irrigation

Irrigation usage in Missouri ranges from supplemental on upland areas to ensure adequate moisture during key crop growth stages to essential in sandy alluvial soils and in production of rice or specialty crops. Application methods are primarily sprinkling, furrow and flood, and use in Missouri is increasing. Between 1987 and 1992 irrigated acreage in Missouri increased from 529,000 acres or 4.5 percent of harvested cropland acres to 705,000 acres or 5.8 percent of Missouri harvested cropland acreage, a 33 percent increase. (Bureau of the Census, 1997.) Missouri continued to increase the amount of irrigated acres through the l990's, as is indicated in the 1997 Census of Agriculture with 832,591 irrigated acres.
(US Census of Agriculture): http://www.nass.usda.gov/census/.

Generally irrigation water sources are plentiful in Missouri, and energy costs low, allowing application methods and management practices which make inefficient use of water resources and chemicals. Over-application contributes to increased pumping costs and reduced nutrient and pesticide efficacy due to leaching or runoff which in turn requires additional chemical inputs. "Chemigation" and "fertigation," the delivery of chemicals and fertilizer through irrigation, are efficient application methods, but may become ground water pollution point sources when backflow devices are not a part of the system.

Agricultural fertilizers and chemicals removed from their target site and use become pollutants. Irrigation management methods developed in areas of the country where irrigation water is costly and scarce are designed to reduce off-site movement of irrigation water and its associated chemical load. Some of those methods, i.e. surge and side inlet rice irrigation are useful and applicable in Missouri. Site specific irrigation management methods considering soil type and water holding capacity, topography, crop moisture needs, rainfall, soil moisture and nutrient and pesticide management plans require closer attention to irrigation management and possibly changes in application methods and equipment used, but can significantly reduce material input costs, yield loss, and the potential for nonpoint source pollution.

Riparian Corridors

One pervasive result of crop production has been degradation or destruction of riparian corridors, much of which occurred early in the 20th century when channelization was customary and recommended. Whether for preventing flooding, farming convenience or for placing more land into production, streams have been straightened, forested or vegetated buffer strips have been removed, and farming occurs directly to the stream bank. The results to streams are increased

sedimentation from destabilized stream banks, loss of pollutant trapping effects from vegetation, increased temperature and evaporation, lowered dissolved oxygen and a degraded physical habitat.

Good physical habitat usually means a mixture of shallow, fast-flowing riffles, deep quiet pools and areas of medium depth and current speed. It also means a mixture of stream substrate sizes ranging from boulders to large cobbles to gravels, sands and silt, scattered emergent aquatic plants, rootwads and downed trees. In short, good habitat means a mixture of physical attributes of the stream channel.

These conditions are more common in Ozark streams where the rock strata weather into coarse cobble and gravel as well as finer sized material, and where there is a good mixture of pools and riffles, wooded stream banks, rootwads and dead falls. This type of diverse aquatic habitat is much less common in other areas of the state.

Regional geology and upstream land use in Glacial Till and Osage Plains make for a less diverse aquatic habitat. The till and the rock strata of the plains weather into sands and silts so that stream substrates are finer and less stable than in Ozark streams. These factors in combination with channelization and removal of riparian corridors result in fewer pools and riffles and contribute to higher temperatures, increased evaporation and the inability of many of these streams to maintain flow in dry weather.

Researchers have found these factors, rather than water quality, to be responsible for significant differences in fish and aquatic invertebrate communities; among these, maximum water temperature, siltation, and minimum dissolved oxygen appear to be important. These factors, particularly dissolved oxygen and temperature, correlate well with the condition of the riparian zone; heavily degraded riparian zones have more bank erosion, higher maximum temperatures, and lower minimum dissolved oxygen levels (Smale, et al., 1992).

Nonpoint Source Controls

Control of nonpoint water pollution sources such as runoff from farms, cities, mining areas and construction sites is still essentially a voluntary program. Regulations are in place to prevent leakage from underground storage tanks and for the secondary containment of bulk agricultural chemical storage sites. Large sand and gravel mining operations require a general NPDES permit for stormwater and smaller operations have been provided with guidelines for best management practices (BMPs). A Land Reclamation Permit is required of larger mining operations as well as a 404 permit required for some sand and gravel operations. Stormwater runoff discharge permits are now issued for construction sites and other areas with less than five acres of bared ground. The Water Protection Program has reduced the size of bared ground requiring a stormwater permit from five acres to one acre.

Control of many nonpoint sources, such as agricultural erosion from cropland and pasture, runoff of fertilizer, pesticides and animal waste, are addressed by Missouri’s nonpoint source management program. This program works with federal, state and local governments, universities, private groups and individual landowners to implement watershed projects that demonstrate nonpoint source control practices and often monitor water quality results.

Programs with dedicated funding sources have worked best. A tax on coal has funded reclamation of abandoned coal mine lands nationwide, although the federal grant was not awarded to Missouri for 2004. Fourteen years of such reclamation in Missouri has reduced the number of stream miles impaired by acid mine drainage from about 100 down to 15. A state sales tax for soil erosion control started providing funds for watershed level soil erosion control programs in 1985. This program, coupled with federal soil conservation programs, is reducing soil erosion in Missouri based on the findings of periodic National Resource Inventories.

Major Water Pollution Sources and Contaminants

TABLE 3. MAJOR WATER POLLUTION SOURCES IN MISSOURI CLASSIFIED WATERS
(Stream Miles or Lake Acres Impaired)

Source	Stream Miles Impaired	Percent of Total Miles	Lake Acres Impaired	Percent of Total Acres
Agriculture	7,701.9	35	45,138	15
Crop Production/Grazing	7,688.4	35	45,138	15
Confined Animal Feeding	4.0	*		
Hydromodification	3,775.9	17	11,780	4
Channelization	3,711.4	17		
Flow Regulation/Modific.	43.5	*	11,780	4
Streambank Mod./Destab.	21	*		
Mining	172.3	1		
Municipal and other Domestic Point Sources	87.1	*	43110	15
Urban Runoff and Construction	53.5	*	825	*
Industrial Point Sources	11.6	*		
Landfills	0.3	*		
Recreational Activities	7	*		
Atmospheric Deposition	1,114	5	76,805	26
Natural Sources	162.5	1		
Unknown	5	*	182	*

* less than 1 %

TABLE 4
MAJOR CONTAMINANTS IN MISSOURI CLASSIFIED WATERS

Contaminant	Stream Miles Impaired	% of Total Miles	Lake Acres Impaired	% of Total Acres
Sediment	7,741.4	35	--	--
Habitat Degradation	3,734.3	17	--	--
Organic Enrichment /Low D.O.	59.5	*	1780	1
Metals Mercury	1,444.0 1,111.0	6 5	86,805 76,805	30 26
Bacteria	48.5	*	137	*
Ammonia	18.3	*	--	--
Pesticides	24	*	1,385	*
Suspended Solids	8.8	*	--	--
Nutrients	7.4	*	44,578	15
TDS: Sulfate, Chloride	39	*	--	--
Flow Alterations			50	*
Chlorine	0.4	*		
pH	13.3	*		
Thermal Modification	1.4	*		
Unknown	21.7	*		

* less than 1 %.
2002 305b Report

Best Management Practices (BMPs)
In general the following three aspects of agricultural production are critical to determining what effect agriculture has on water quality and which BMPs will be the most effective.

Some common agricultural pollutants resist degradation once they enter water bodies. Evidence shows that atrazine, for example, can remain in large lakes and reservoirs for months. Consequently, it is important to detect risks to drinking water and aquatic habitat early where technologies may prevent pollution from getting into the water in the first place.

Agricultural pollutants have a tendency to travel once they are waterborne. Therefore, assessing the vulnerability or actual degradation of water quality associated with agriculture may entail monitoring fairly large drainage systems. For example, pollution loadings near a single farm may be too low to trigger concern, but pollutants transported through streams and rivers from

many farms can accumulate to significant amounts at some terminal drainage points. An example occurs in the Mississippi Drainage Basin where pesticide, nutrient and sediment loadings accumulate and reach hundreds of thousands of tons by the time the river reaches the Gulf Coast estuaries of Louisiana.

Surface water, ground water, wetlands and water conservation conditions are interrelated. Movements of nutrients and pesticides between ground water and surface water are well documented. As discussed above, use of BMPs designed to prevent erosion may have adverse effects on quality of both surface and ground water (Office of Technology Assessment, 1995).

Wide ranges of voluntary and incentive programs are in place, the majority of which are designed to prevent soil erosion. Assistance is available in the form of educational materials, technical assistance, training, specialized mechanical equipment, cost-share assistance and incentive payments. A discussion of those programs may be found in the Implementation Assistance Section, Appendix J. An extensive list of best management practices is included at the end of this agriculture section. New, innovative practices which have yet to establish a proven track record may also be considered on a site specific basis as long as monitoring is included to prove or disprove the practice's efficacy.

ANIMAL PRODUCTION

Characterization

It is well documented that the animal production contributions to Missouri's economy are significant and continuing to increase. All animal sectors are experiencing growth in the number of larger operations while the total number of operations is continuing to decline.

Medium Concentrated Animal Feeding Operation (Medium CAFO)

The term Medium CAFO includes any AFO with the type and number of animals that fall within any of the ranges listed below and which has been defined or designated as a CAFO. An AFO is defined as a Medium CAFO if:

The type and number of animals that it stables or confines falls within any of the following ranges:

200 to 699 mature dairy cows, whether milked or dry;

300 to 999 veal calves;

300 to 999 cattle other than mature dairy cows or veal calves. Cattle includes but is not limited to heifers, steers, bulls and cow/calf pairs;

750 to 2,499 swine each weighing 55 pounds or more;

3,000 to 9,999 swine each weighing less than 55 pounds;

150 to 499 horses;

3,000 to 9,999 sheep or lambs;

16,500 to 54,999 turkeys;

9,000 to 29,999 laying hens or broilers, if the AFO uses a liquid manure handling system;

37,500 to 124,999 chickens (other than laying hens), if the AFO uses other than a liquid manure handling system;

25,000 to 81,999 laying hens, if the AFO uses other than a liquid manure handling system;

10,000 to 29,999 ducks (if the AFO uses other than a liquid manure handling system); or

1,500 to 4,999 ducks (if the AFO uses a liquid manure handling system); and
Either one of the following conditions are met:
Pollutants are discharged into waters of the United States through a man-made ditch, flushing system, or other similar man-made device; or
Pollutants are discharged directly into waters of the United States which originate outside of and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation. [40 CFR 122.23(b)(6)]
Animal production facilities considered nonpoint sources are generally small operations. Animal operations with livestock numbers greater than those referenced above are required to have NPDES permits and are, therefore, point sources by definition. Smaller operations may also be designated as point sources for permit purposes based on site-specific conditions (e.g., discharges). The new Concentrated Animal Feeding Operation (CAFO) rules published February 12, 2003, in the *Federal Register* were adopted within the authority of the 1972 Clean Water Act as amended to address changes in the animal production industries and their developments. These new rules are the result of more than 3 years of high-profile study and input from the animal feeding industry, academia, environmental groups, and the general public through which EPA considered a wide range of potential options that were evaluated technically and economically.

EPA's revisions to the original regulations make the regulations more effective for the purpose of protecting or restoring water quality. The revisions also make the regulations easier to understand and better clarify the conditions under which an AFO is a CAFO, and therefore, subject to the regulatory requirements. They are more inclusive of certain sectors of the CAFO industries, removed several registration exemptions, reflect a greater focus on land application of manure and wastewater, and emphasize accountability, inspections, and record-keeping while retaining appropriate state flexibility.

There are 20 Class I and 380 Class II confined animal feeding operations (CAFOs) located in Missouri. These facilities generate large amounts of animal manure and have the potential to cause serious water pollution problems. We are also concerned by cumulative impacts of numerous small animal production facilities.
For more information regarding the CAFO rule and related materials, select the following links: http://cfpub.epa.gov/npdes/afo/cafofinalrule.cfm or http://agebb.missouri.edu/commag/news/srcafo.htm.

Nonpoint Source Impacts

Nonpoint sources of pollution related to animal production include four major areas: eutrophication or nutrient enrichment, pathogens, ammonia toxicity, and riparian habitat disruption. The first two are related to the management of animal waste which are generally applicable to all animal types while the third is related only to pastured animals. In addition, animal food additives such as metals (copper, selenium, mercury, etc.), hormones and antibiotics may have impacts on aquatic organisms or human populations. Metals in runoff may have chronic or acute impacts on aquatic organisms, hormones may cause the disruption of reproduction in aquatic animals and antibiotics may support the proliferation of antibiotic resistant strains.

Nutrients/Eutrophication

Excess nutrients may have water quality impacts on beneficial uses of streams and lakes as well as ground water. Aquatic life may be impaired by the growth and subsequent decomposition of algae and aquatic macrophytes with the resulting depletion of dissolved oxygen in the water column. One form of nitrogen, ammonia, is toxic to aquatic life at certain levels. Species of fish and invertebrates may be replaced by more tolerant species. Aesthetic impairment may also occur. In waters used for drinking water supply, taste and odor problems can be caused by the proliferation of organism growth due to high levels of nutrients entering the water. Organic matter in drinking water supplies can cause increased levels of trihalomethanes in finished drinking water. The nitrate form of nitrogen can cause health problems in children (methemoglobinemia).

Pathogens

Animal waste has potential for spreading or encouraging pathogens that may damage aquatic life or humans. Algal toxicity from eutrophication has been well documented in one Missouri drinking water reservoir earlier this decade (City of Lamar reservoir). Blooms of blue-green algae are becoming more common due to increased nutrient inputs to water sources. The outbreak of *Cryptosporidium*, a parasitic protozoan, in the City of Milwaukee's water supply was attributed to animal waste in drinking water among other possible sources. Although at this point problems associated with *Pfiesteria* appear to be limited to marine or estuarine environments, that organism's toxicity has been linked to nutrient enrichment in the affected waters, and some of those nutrients are attributed to animal production sources.

Ammonia Toxicity

Animal waste typically contains a significant level of ammonia. Fish populations are very sensitive to relatively low levels of ammonia. Most fish kills related to animal waste are caused by ammonia in the waste. The water quality standards contain numeric criteria for ammonia in classified waters, and the level of toxic form of ammonia is related to temperature and pH. Under proper containment and management, animal waste is not discharged to water and the nitrogen in the ammonia form does not run off application sites in any significant concentration.

Riparian Corridors/Sediment

Livestock with free access to waters generally cause bank instability, bank sloughing and erosion of the riparian area, in addition to the direct introduction of nutrients and possibly pathogens into the water. The loss of vegetation contributes to increased temperature and evaporation, lowered dissolved oxygen and a degraded habitat. In addition to the immediate impacts in the riparian area, the filtering properties of the riparian strip, which would otherwise buffer the water from sediment or other contaminants, are lost.

Best Management Practices (BMPs)

In general the best management practices for animal production emphasize the physical separation of animals and their wastes from waters. This is accomplished in several ways: 1) management of animal wastes such that wastes that are collected are prevented from running off directly into waters; 2) wastes that are utilized as fertilizers and applied at agronomic rates such that there is no excess nutrient load which could leach or run off into waters from the fields to which they were applied, and 3) livestock are separated from waters.

A wide range of voluntary and incentive programs are in place, the majority of which are designed to prevent pollution by animal waste or the degradation of riparian areas by animal use. Assistance is available in the form of educational materials, technical assistance, training, specialized mechanical equipment, cost-share assistance and incentive payments, both for management as well as pollution prevention or habitat restoration. A discussion of those programs may be found in the Implementation Assistance Section, Appendix J. An extensive list of best management practices is included at the end of this agriculture section.

Recommendations

The Farm Security and Rural Investment Act of 2002 is landmark legislation for conservation funding and for focusing on environmental issues. The conservation provisions will assist farmers in meeting environmental challenges on their land. This legislation simplifies existing programs and creates new programs to address high priority environmental and production goals. The 2002 Farm Bill enhances the long-term quality of our environment and conservation of our natural resources. (2002 USDA Farm Bill): http://www.usda.gov/farmbill/

Nonpoint source water pollution must be addressed within the context of sustainability; solutions must be economically and environmentally sound. Nonpoint source funding and project efforts should address information and education, to develop awareness of problems, their causes and solutions, emphasizing practices that protect environmental quality and economic viability. Demonstrations and technical assistance should be used to provide reasonable, effective alternatives. Projects should focus on sustainable strategies incorporating management systems such as whole farm planning; integrated crop management; integrated pest management; realistic yield goals, restoration of riparian corridors; alternative crops or farming systems, e.g. intensively managed grazing or agroforestry versus row crop production; etc.

Temporary or permanent riparian corridor and wetland conservation easements could provide substantial water quality and habitat benefits. One ~~major~~ impediment to easement establishment appears to be continued tax liability to the landowner. Removal or reduction of the tax liability on property consigned to long term conservation easements could make the practice more attractive to landowners.

On March 9, 1999, USDA and EPA released the Unified National Animal Feeding Operations Strategy. This strategy includes actions contemplated with regard to nonpoint sources as well as permitted animal feeding operations. Copies of the strategy are available at USDA-NRCS field offices and the state office. Copies are also available from the Missouri Manure Management Action Group via the internet at http://outreach.missouri.edu/mommag.

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AGRICULTURAL BEST MANAGEMENT PRACTICES

Agricultural Best Management Practices (BMPs) for pollution control are those management practices and structural measures which are determined to be the most effective, practicable means of controlling and preventing pollution from agricultural activities. BMPs are singular practices that, when put together in combination with other practices, will reduce soil erosion, nutrient and pesticide runoff or leaching, and manage animal manures. BMPs are actions taken by each individual agricultural operation for the achievement of production and water quality protection.

Appropriate management practices for individual farms may vary with the specific cropping, topographical, environmental, and economic conditions existing at a given site. Due to these variables, it is not possible to recommend uniform BMPs for farms

A detailed, but not all inclusive, listing of a number of specific practices and management measures which can be employed to control or reduce the risk of agricultural pollution and their potential impacts are contained in the listings which follow. Technical specifications may be found in the *Field Office Technical Guide* maintained by the USDA Natural Resources Conservation Service http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=MO.

BMPs and land use changes are most effective when selected and installed as integral parts of a comprehensive resource management plan based on natural resource inventories and assessment of management practices. The result is an approach using the Best Management Systems concept. Best Management systems use BMPs and land use changes which are designed to be complementary, and when used in combination are more technically sound than each practice separately. Components selected in plan development must consider the over-all desired result; therefore, the opportunity to incorporate new and developing technologies and innovative practices must remain viable.

NONPOINT SOURCE WATER QUALITY
CONSERVATION PRACTICE EFFECTS RANKING*
11/03

Significant Positive Water Quality Benefit or Control	**+2**
Good Water Quality Benefit or Control	**+1**
Negligible Water Quality Benefit or Control	**0**
Negative Water Quality Impact	**-1**
Significant Negative Water Quality Impact	**-2**
Variable (Positive or Negative) Water Quality Impact	**+/-**
Conservation Practice Not Applicable to Water Quality	**NA**

* The numeric ranking is intended to be only a general guideline. Positive and negative impacts will vary from site to site. The conservation practices listed are examples and may change for each specific location. Specific conservation practices may be used for more than one resource concern.

Soil Tilth, Crusting, Water Infiltration, Organic Materials
Soil condition based on suitable combinations of mineral, water, air, organic matter, resulting in proper habitat for microbial activity and chemical reactions to occur.

Soil Compaction
Excess compression of soil particles and aggregates by machine, livestock, and natural consolidation, thereby affecting plant-soil-moisture-air relationships.

Soil Contaminants

Other Excess Animal Manures and Organics
Excess animal waste and other organics restrict the desired soil use.

Excess Fertilizers
Quantity of nutrients restricts desired soil use.

Damage On-site
Need to rework ground due to sediment thickness and distribution; crops destroyed; infertile deposition, especially for coarse textured soils.

Damage Off-site
Same as on-site damage. Off-site practice effects are less than on-site because of increased distance from source of problem.

Suspended Sediment and Turbidity
Suspended sediment is sediment held in surrounding fluid; turbidity is reduced clarity of fluids due to the presence of matter.

Aquatic Habitat Suitability
Water quality and physical nature of the stream provide a suitable home for fish and other aquatic life.

TABLE 5: NONPOINT SOURCE WATER QUALITY IMPACTS DERIVED FROM EROSION CONTROL PRACTICES APPLIED TO AGRICULTURAL LANDS FOR (SEDIMENT) 11/03

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL TILTH, CRUSTING, WATER INFILTRATION, ORGANIC MATERIALS	SOIL COMPACTION	SOIL CONTAMINANTS			DAMAGE ONSITE	DAMAGE OFFSITE	SUSPENDED SEDIMENT AND TURBIDITY	AQUATIC HABITAT SUITABILITY
			OTHER EXCESS ANIMAL MANURES AND ORGANIC	EXCESS FERTILIZERS	EXCESS PESTICIDES				
ACCESS ROAD (560)	NA	+1	+2	+1	+1	+1	+1	+1	+1
BRUSH MANAGEMENT (BIOLOGICAL) (314B)	+1	+1	0	0	+1	+2	+1	+1	+/-
BRUSH MANAGEMENT (CHEMICAL) (314C)	+1	+1	0	0	-2	+2	+1	+1	+/-
BRUSH MANAGEMENT (MECHANICAL) (314M)	+1	-1	0	0	NA	+/-	+/-	-1	-1
BRUSH MANAGEMENT (BURNING) (314F)	+/-	+/-	0	0	NA	+/-	+/-	-1	-1
CHISELING AND SUB-SOILING (324A)	+1	+2	0	0	0	0	0	+1	NA
CHISELING AND SUB-SOILING (324B)	+1	+2	0	0	0	0	0	+1	NA
CLEARING AND SNAGGING (326)	NA	NA	NA	NA	NA	+/-	-1	-1	-2
COMMERCIAL FISHPONDS (397)	0	0	+2	+1	+1	+1	+1	+1	+1
CONSERVATION COVER (327)	+2	+1	+1	+1	+1	+2	+2	+1	+1
CONSERVATION CROP ROTATION (328)	+2	+2	+1	+1	+1	+1	+1	+1	+1
CONTOUR BUFFER STRIPS (332)	UNDETERMINED	UNDETERMINED	+2	+2	+2	+2	+2	+2	+2

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants			Damage Onsite	Damage Offsite	Suspended Sediment and Turbidity	Aquatic Habitat Suitability
			Other excess animal manures and organic	Excess fertilizers	Excess pesticides				
Contour Farming (330)	+2	0	+1	+1	+1	+2	+2	+1	0
Cover and Green Manure Crop (340)	+2	+2	+1	+1	+1	+2	+2	+1	+1
Critical Area Planting (342)	+2	+2	+1	+1	+1	+2	+2	+1	+1
Cross Wind Ridges (589a)	+1	+1	+1	+1	+2	+2	+2	+1	+1
Cross Wind Strip Crop (589b)	+2	+1	+1	+1	+1	+2	+2	+1	+1
Cross Wind Trap Strip (589c)	+1	+1	+1	+1	+1	+2	+2	+1	+1
Dam, Diversion (348)	+1	+1	+1	+1	+1	+1	+1	+1	0
Dam, Floodwater Retarding (402)	0	0	+1	+1	+1	+1	+1	+1	+1
Dam, Multiple Purpose (349)	0	0	+1	+1	+1	+/-	+/-	+1	+1
Deferred Grazing (352)	+2	+1	+2	+2	+2	+1	+1	+1	+1
Deep Tillage (Interim) (xxx)	+1	+2	+/-	+/-	+/-	NA	+/-	+/-	NA
Dike (Earthen) (356)	0	0	+1	+1	+1	+1	+1	+1	+1
Diversion (362)	0	0	+1	+1	+1	+1	+1	+1	0
Fencing (382)	+1	+1	+1	+1	+1	+1	+1	+1	+1
Field Border (386)	+1	+1	+1	+1	+1	+1	+1	0	+1

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants			Damage Onsite	Damage Offsite	Suspended Sediment and Turbidity	Aquatic Habitat Suitability
			Other excess animal manures and organic	Excess fertilizers	Excess pesticides				
Field Windbreak (392)	+1	+1	+1	+1	+1	NA	NA	+1	+1
Filter Strip (393)	0	0	+1	+1	+1	+2	+1	+2	+2
Firebreak (394)	+1	NA	+/-	+/-	+/-	NA	NA	+/-	NA
Fishpond Management (399)	NA	NA	+1	+1	+1	NA	NA	+1	+1
Forest Stand Improvement (666)	+1	-1	NA	NA	+/-	+	+	+/-	NA
Grade Stabilization Structure (410)	NA	NA	0	0	0	+1	+1	+1	0
Grassed Waterway (412)	0	0	+/-	+/-	+/-	+1	+1	+1	0
Grasses and Legumes(Rotation) (411)	+2	+1	+1	+1	+2	+1	+1	+2	+1
Heavy Use Area Protection (561)	+1	+1	+1	+1	+1	+1	+1	+2	+1
Hedgerow Planting (422)	0	+1	+1	+1	+1	+1	+1	+1	+/-
Herbaceous Wind Barriers (422a)	+1	+1	+1	+1	+1	+1	+1	+1	+/-
Irrigation Field Ditch (388)	0	0	-1	-1	-1	0	0	+/-	0
Irrigation Land Leveling (464)	0	+/-	+1	+1	+1	0	0	+1	0
Irrigation Pit (552)	0	0	+1	+1	+1	+1	+1	+1	0

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants			Damage Onsite	Damage Offsite	Suspended Sediment and Turbidity	Aquatic Habitat Suitability
			other excess animal manures and organic	excess fertilizers	excess pesticides				
Irrigation Storage Reservoir (436)	**0**	**0**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**0**
Irrigation System - Trickle (Micro) (441)	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**0**
Irrigation System - Sprinkler (442)	**-1**	**+1**	**+1**	**+1**	**+1**	**+2**	**+2**	**+2**	**0**
Irrigation System - Surface and Subsurface (443)	**0**	**-1**	**+1**	**+1**	**+1**	**+1/+2**	**+1/+2**	**+1**	**-1**
Irrigation System - Tailwater Recovery (447)	**0**	**0**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Irrigation Water Conveyance - (Ditch) (428)	**0**	**NA**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Irrigation Water Conveyance -(Pipeline) (430)	**0**	**NA**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Irrigation Water Management (449)	**+2**	**+1**	**+1**	**+1**	**+1**	**+2**	**+2**	**+1**	**+1**
Land Reconstruction (Abandoned Mine Land) (543)	**+1**	**+1**	**+1**	**+1**	**+1**	**+2**	**+2**	**0**	**0**
Land Reconstruction (Current Mine Land) (544)	**+1**	**+1**	**0**	**0**	**0**	**+2**	**+2**	**+1**	**+1**
Land Smoothing (466)	**+/-**	**0**	**+/-**	**+/-**	**+/-**	**0**	**0**	**0**	**0**
Lined Waterway or Outlet									

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants			Damage Onsite	Damage Offsite	Suspended Sediment and Turbidity	Aquatic Habitat Suitability
			other excess animal manures and organic	excess fertilizers	excess pesticides				
(468)	**0**	**0**	**0**	**0**	**0**	**+1**	**+1**	**+/-**	**0**
Mulching (484)	**+2**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Nutrient Management (Deficit) (590d)	**-1**	**NA**	**+/-**	**+/-**	**NA**	**0**	**0**	**+1**	**+1**
Nutrient Management (Excess) (590e)	**+2**	**NA**	**-2**	**-2**	**NA**	**0**	**0**	**-1**	**+1**
Obstruction Removal (500)	**0**	**0**	**0**	**0**	**0**	**-1**	**-1**	**-1**	**-2**
Open Channel (582)	**NA**	**NA**	**0**	**0**	**0**	**+1**	**+1**	**-1**	**-2**
Pasture and Hayland Management (510)	**+2**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**0**
Pasture and Hayland Planting (512)	**+2**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Pest Management (Biological) (595b)	**NA**	**NA**	**NA**	**NA**	**+2**	**0**	**0**	**0**	**NA**
Pest Management (Chemical) (595c)	**NA**	**NA**	**NA**	**NA**	**+2**	**+/-**	**+/-**	**0**	**NA**
Pest Management (Mechanical) (595m)	**NA**	**NA**	**NA**	**+1**	**+2**	**+/-**	**+/-**	**+/-**	**NA**
Pipeline (516)	**0**	**0**	**NA**	**NA**	**NA**	**0**	**0**	**NA**	**NA**
Planned Grazing System (556)	**+2**	**0**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Pond (378)	**NA**	**0**	**+/-**	**+/-**	**+/-**	**+1**	**+1**	**0**	**0**

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants			Damage Onsite	Damage Offsite	Suspended Sediment and Turbidity	Aquatic Habitat Suitability
			Other excess animal manures and organic	Excess fertilizers	Excess pesticides				
Pond Sealing or Lining (521)	+1	+1	0	0	0	0	0	0	0
Poultry Composting Facility (313A)	0	0	+2	+1	+1	+1	+1	+2	+2
Precision Land Forming (462)	0	0	+1	+1	+1	0	0	0	0
Prescribed Burning (338)	Undetermined	NA	-1	-1	+1	0	0	-1	~~-1~~ +/-
Proper Grazing Use (528)	+1	0	+1	+1	0	+1	-1	+1	+1
Proper Woodland Grazing (530)	-1	-1	0	0	NA	-1	-1	-1	-1
Pumping Plant for Water Control (533)	0	0	0	0	0	0	0	0	0
Recreation Area Improvement (562)	+1	+1	+1	+1	+1	+1	+1	+1	+1
Recreation Land Grading and Shaping (566)	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
Recreation Trail and Walkway (568)	+1	+1	+/-	+/-	0	+1	+1	+1	+1
Residue Management (No Till/ Strip) (329A)	+2	+2	+1	+1	+1	+1	+1	+1	+1
Residue Management (Mulch Till) (329B)	+2	+1	+1	+1	+1	+1	+1	+1	+1
Residue Management	+2	+1	+1	+1	+1	+1	+1	+1	+1

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL TILTH, CRUSTING, WATER INFILTRATION, ORGANIC MATERIALS	SOIL COMPACTION	SOIL CONTAMINANTS			DAMAGE ONSITE	DAMAGE OFFSITE	SUSPENDED SEDIMENT AND TURBIDITY	AQUATIC HABITAT SUITABILITY
			OTHER EXCESS ANIMAL MANURES AND ORGANIC	EXCESS FERTILIZERS	EXCESS PESTICIDES				
(RIDGE TILL) (329R)									
RESIDUE MANAGEMENT (SEASONAL) (344)	+2	+1	+1	+1	+1	+1	+1	0	+1
RIPARIAN FOREST BUFFER (391)	+1	+1	+2	+2	+2	+1	+1	+2	+2
ROW ARRANGEMENT (557)	+1	+1	+1	+1	+1	+1	+1	+1	0
RUNOFF MANAGEMENT SYSTEM (570)	+1	+1	+1	+1	+1	+2	+2	+2	0
SEDIMENT BASIN (350)	0	0	+1	+1	+1	+2	+2	+2	+1
SPOIL SPREADING (572)	0	-1	+/-	+/-	+/-	-1	-1	0	0
SPRING DEVELOPMENT (574)	0	0	0	NA	NA	0	0	+1	0
STREAMBANK AND SHORELINE PROTECTION (580)	0	0	+1	+1	+1	+1	+1	+1	+1
STREAM CHANNEL STABILIZATION (584)	0	0	+1	+1	+1	+1/+2	+1/+2	+1	+1
STRIPCROPPING (CONTOUR) (585)	+2	+1	+2	+2	+2	+1	+1	+1	+1
STRIPCROPPING (FIELD) (585)	+1	+1	+2	+2	+2	+1	+1	+1	+1
STRUCTURE FOR WATER CONTROL (587)	0	+1	+1	+1	+1	0	0	0	+2
SUBSURFACE DRAIN (606)	+1	+1	-1/-2	-1/-2	-1/-2	+1	+1	+1	-2

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants			Damage Onsite	Damage Offsite	Suspended Sediment and Turbidity	Aquatic Habitat Suitability
			Other excess animal manures and organic	Excess fertilizers	Excess pesticides				
Surface Drainage Field Ditch (607)	+1	+1	-1	-1	-1	0	0	-1	-1
Surface Drainage Main or Lateral (608)	+1	+1	-1	-1	-1	0	0	-1	-1
Surface Roughening (609)	0	0	0	0	0	0	+/-	+/1	NA
Terraces (Gradient) (600g)	0	0	+1	+1	+1	+2	+2	+1	0
Terraces (Storage) (600s)	0	0	+/-	+/-	-1	+2	+2	+1	0
Tree / Shrub Planting (612)	+1	+1	+1	+1	+1	+1	+1	+1	+1
Trough or Tank (614)	0	0	+1	+1	NA	0	0	+1	+1
Underground Outlets (620) *	NA	NA	+2/-2	+2/-2	+2/-1	0	0	+1	0
Use Exclusion (472)	+2	+1	+1	+1	+1	+1	+1	+1	+1
Vertical Drain (630)	0	0	+1	+1	+1	0	0	+1	0
Waste Management System (312)	+2	NA	+2	+2	NA	0	0	+1	+1
Waste Storage Pond (425)	NA	NA	+2	+2	NA	NA	NA	+1	+1
Waste Storage Structure (313)	NA	NA	+2	+2	NA	NA	NA	+1	+1
Waste Treatment Lagoon (359)	NA	NA	+2	+2	NA	NA	NA	+1	+1
Waste Utilization (633)	+1	NA	+2	+2	NA	0	0	+1	+1
Water and Sediment Control Basin (638)	0	0	-1/+1	-1/+1	-1/+1	+2	+2	+2	+1
Well (Irrigation) (642i)	NA	NA	0	0	0	0	0	0	0

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL TILTH, CRUSTING, WATER INFILTRATION, ORGANIC MATERIALS	SOIL COMPACTION	SOIL CONTAMINANTS			DAMAGE ONSITE	DAMAGE OFFSITE	SUSPENDED SEDIMENT AND TURBIDITY	AQUATIC HABITAT SUITABILITY
			OTHER EXCESS ANIMAL MANURES AND ORGANIC	EXCESS FERTILIZERS	EXCESS PESTICIDES				
WELL (LIVESTOCK AND WILDLIFE) (642L)	NA	NA	0	0	0	0	0	0	0
WETLAND RESTORATION (INTERIM) (657)	+/-	NA	+2	+2	+2	0	0	+2	+2
WILDLIFE UPLAND HABITAT MANAGEMENT (645)	+2	+2	+2	+2	+2	0	0	+2	+1
WILDLIFE WATER FACILITY (648)	NA	NA	0	0	0	0	0	0	0
WILDLIFE WETLAND HABITAT MANAGEMENT (644)	+2	+2	+2	+2	+2	+2	0	0	+2
WINDBREAK/SHELTERBELT ESTABLISHMENT (380)	0	+1	+1	+1	+1	NA	NA	+1	+1
WOODLAND IMPROVED HARVEST (FINAL) (654F)	+1	+1	NA	NA	NA	+1	+1	+/-	NA
WOODLAND IMPROVED HARVEST (INTERMEDIATE THIN) (654I)	+1	+1	NA	NA	NA	+1	+1	+/-	+/-
WOODLAND PRUNING (660)	NA	NA	NA	NA	NA	NA	NA	NA	NA
WOODLAND SITE PREPARATION (490)	+/-	+/-	+/-	+/-	+/-	0	-1	-1	-1
~~WOODY ROOT PRUNING (INTERIM) (747)~~	~~0~~	~~NA~~	~~+/-~~	~~+/-~~	~~NA~~	~~0~~	~~0~~	~~+/-~~	~~NA~~

Note: The Conservation Practice Effects for Underground Outlets (620) depends on where the tile outlets: directly into a stream or onto vegetation.

TABLE 6: Nonpoint SOURCE WATER QUALITY IMPACTS DERIVED FROM NUTRIENT MANAGEMENT PRACTICES APPLIED TO AGRICULTURAL LANDS (11/03)

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL CONTAMINANTS		GROUND WATER CONTAMINANTS	SURFACE WATER CONTAMINANTS		AQUATIC HABITAT SUITABILITY
	EXCESS ANIMAL MANURES AND OTHER ORGANICS	EXCESS FERTILIZERS	NUTRIENTS AND ORGANICS	NUTRIENTS AND ORGANICS	LOW DISSOLVED OXYGEN	
ACCESS ROAD (560)	0	0	+1	+1	0	+1
CHISELING AND SUB-SOILING (324A)	+/-	+/-	-1	+1	+1	+1
CHISELING AND SUB-SOILING (324B)	+/-	+/-	-1	-1/+1	-1/+1	+1
CLEARING AND SNAGGING (326)	0	0	0	0	0	-1
COMMERCIAL FISHPONDS (397)	+1	+1	+2	+1	+1	+1
CONSERVATION COVER (327)	+1	+1	+1	+1	+1	+1
CONSERVATION CROP ROTATION (328)	+2	+2	+1	+1	+1	+1
CONTOUR BUFFER STRIP (332)	+1	+1	+1	+2	+1	+2
CONTOUR FARMING (330)	+1	+1	+1	+1	0	0
COVER AND GREEN MANURE CROP (340)	+2	+2	+1	+1	0	+1
CRITICAL AREA PLANTING (342)	+1	+1	+1	+1	0	+1

Conservation Practice/ (NRCS Code)	Soil Contaminants		Ground Water Contaminants	Surface Water Contaminants		Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Excess Fertilizers	Nutrients and Organics	Nutrients and Organics	Low Dissolved Oxygen	
Cross Wind Ridges (589a)	+1	+1	+1	+1	0	+1
Cross Wind Strip Crop (589b)	+1	+1	+1	+1	+1	+1
Cross Wind Trap Strip (589c)	+1	+1	+1	+1	+1	+1
Dam, Diversion (348)	0	0	0	+1	+1	0
Dam, Floodwater Retarding (402)	0	0	+1	+1	+1	+1
Dam, Multiple Purpose (349)	0	0	0	+1	+1	+1
Deferred Grazing (352)	+2	+2	+2	+1	+1	+1
Deep Tillage (Interim) (xxx)	+1	+1	+1	+1	+1	NA
Dike (Earthen) (356)	0	0	0	+1	+1	+1
Diversion (362)	0	0	0	+1	+1	0
Fencing (382)	+1	+1	+1	+1	+1	+1
Field Border (386)	+1	+1	NA	+1	NA	+1
Field Windbreak (392)	+1	+1	+1	+1	+1	+1
Filter Strip (393)	0	0	+1	+1	+1	+2
Fishpond Management (399)	NA	NA	0	+1	0	0

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL CONTAMINANTS		GROUND WATER CONTAMINANTS	SURFACE WATER CONTAMINANTS		AQUATIC HABITAT SUITABILITY
	EXCESS ANIMAL MANURES AND OTHER ORGANICS	EXCESS FERTILIZERS	NUTRIENTS AND ORGANICS	NUTRIENTS AND ORGANICS	LOW DISSOLVED OXYGEN	
GRADE STABILIZATION STRUCTURE (410)	NA	NA	0	0	0	0
GRASSED WATERWAY (412)	0	0	0	0	0	0
GRASSES AND LEGUMES (ROTATION) (411)	+2	+2	+2	+1	+1	+1
HEAVY USE AREA PROTECTION (561)	NA	NA	0	+1	+1	+1
HEDGEROW PLANTING (422)	+1	+1	+1	+1	NA	+1
HERBACEOUS WIND BARRIERS (422A)	+1	+1	+1	+1	+1	+1
IRRIGATION FIELD DITCH (388)	+1	+1	0	-1	0	0
IRRIGATION LAND LEVELING (464)	0	0	+1	+1	0	0
IRRIGATION PIT OR REGULATING RESERVOIR (552)	+1	+1	+1	+1	+1	0
IRRIGATION STORAGE RESERVOIR (436)	+1	+1	+1	+1	+1	0
IRRIGATION SYSTEM - TRICKLE (MICRO) (441)	-1	-1	+1	+2	0	0
IRRIGATION SYSTEM –	0	0	+1	+1	+1	0

Conservation Practice/ (NRCS Code)	Soil Contaminants		Ground Water Contaminants	Surface Water Contaminants		Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Excess Fertilizers	Nutrients and Organics	Nutrients and Organics	Low Dissolved Oxygen	
Sprinkler (442)						
Irrigation System - Surface and Subsurface (443)	**0**	**0**	**+2**	**+2**	**+1**	**-1**
Irrigation System - Tailwater Recovery (447)	**-1**	**-1**	**+/-**	**+1**	**+1**	**+1**
Irrigation Water Conveyance - Ditch (428)	**NA**	**NA**	**0**	**0**	**-1**	**0**
Irrigation Water Conveyance -Pipeline (430)	**NA**	**NA**	**0**	**0**	**0**	**0**
Irrigation Water Management (449)	**+2**	**+2**	**+2**	**+2**	**0**	**+1**
Land Reconstruction (Abandoned Mine Land) (543)	**NA**	**NA**	**0**	**+1**	**0**	**0**
Land Reconstruction (Current Mine Land) (544)	**NA**	**NA**	**0**	**0**	**+1**	**+1**
Land Smoothing (466)	**+1**	**+1**	**+1**	**+/-**	**0**	**0**
Lined Waterway or Outlet (468)	**0**	**0**	**0**	**0**	**0**	**0**
Mulching (484)	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**

Conservation Practice/ (NRCS Code)	Soil Contaminants		Ground Water Contaminants	Surface Water Contaminants		Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Excess Fertilizers	Nutrients and Organics	Nutrients and Organics	Low Dissolved Oxygen	
Nutrient Management (Deficit) (590d)	+2	+2	+2	+2	+1	+1
Nutrient Management (Excess) (590e)	+2	+2	+/-	+/-	+1	+1
Open Channel (582)	NA	NA	0	0	+1	-1
Pasture and Hayland Management (510)	+1	+1	+1	+1	+1	0
Pasture and Hayland Planting (512)	+1	+1	+1	+1	+1	0
Planned Grazing System (556)	+1	+1	0	+1	+1	+1
Pond (378)	NA	NA	+/-	0	0	0
Pond Sealing or Lining (521)	0	0	+1	0	0	0
Poultry Composting Facility (313a)	+2	+1	0	+2	+2	+2
Precision Land Forming (462)	+1	+1	+1	+/-	0	0
Prescribed Burning (338)	0	0	0	+/-	~~-1~~ +/-	~~-1~~ +/-
Proper Grazing Use (528)	+1	+1	0	+1	+1	+1
Proper Woodland Grazing						

Conservation Practice/ (NRCS Code)	Soil Contaminants		Ground Water Contaminants	Surface Water Contaminants		Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Excess Fertilizers	Nutrients and Organics	Nutrients and Organics	Low Dissolved Oxygen	
(530)	**0**	**0**	**0**	**0**	**0**	**0**
Pumping Plant for Water Control (533)	**+1**	**+1**	**+2**	**0**	**0**	**0**
Residue management (No Till/ Strip) (329a)	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Residue Management (Mulch Till) (329b)	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Residue Management (Ridge Till) (329r)	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Residue Management (Seasonal) (344)	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Riparian Forest Buffer (391)	**+1**	**+1**	**+2**	**+2**	**+2**	**+2**
Row Arrangement (557)	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Runoff Management System (570)	**NA**	**NA**	**0**	**+1**	**0**	**0**
Sediment Basin (350)	**0**	**0**	**0**	**+1**	**+1**	**0**
~~**Sinkhole Treatment (Interim) (725)**~~	~~**+1**~~	~~**+1**~~	~~**+2**~~	~~**+1**~~	~~**+1**~~	~~**+1**~~
Spoil Spreading (572)	**0**	**0**	**+1**	**0**	**0**	**0**

Conservation Practice/ (NRCS Code)	Soil Contaminants		Ground Water Contaminants	Surface Water Contaminants		Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Excess Fertilizers	Nutrients and Organics	Nutrients and Organics	Low Dissolved Oxygen	
Spring Development (574)	**0**	**0**	**0**	**+1**	**0**	**0**
Streambank and Shoreline Protection (580)	**NA**	**NA**	**0**	**+1**	**+1**	**+1**
Stream Channel Stabilization (584)	**0**	**0**	**0**	**+1**	**+1**	**+1**
Stripcropping (Contour) (585)	**+1**	**+1**	**+2**	**+2**	**+1**	**+1**
Stripcropping (Field) (586)	**+1**	**+1**	**+2**	**+2**	**+1**	**+1**
Structure for Water Control (587)	**+1**	**+1**	**+/-**	**+1**	**+1**	**+2**
Subsurface Drain (606)	**+1**	**+1**	**+1**	**-1/+1**	**0**	**-1/-2**
Surface Drainage Field Ditch (607)	**+1**	**+1**	**0**	**-1**	**-1**	**-1**
Surface Drainage Main or Lateral (608)	**+1**	**+1**	**0**	**-1**	**-1**	**-1**
Surface Roughening (609)	**0**	**0**	**0**	**+2**	**+1**	**+1**
Terraces (Gradient) (600g)	**+1**	**+1**	**0**	**+1**	**+1**	**0**
Terraces (Storage) (600s)	**+1**	**+1**	**0**	**-1/+1**	**+1**	**0**

Conservation Practice/ (NRCS Code)	Soil Contaminants		Ground Water Contaminants	Surface Water Contaminants		Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Excess Fertilizers	Nutrients and Organics	Nutrients and Organics	Low Dissolved Oxygen	
Tree / Shrub Planting (612)	+1	+1	+1	+1	+1	+1
Underground Outlets (620)	0	0	0	-1/+1	0	0
Use Exclusion (472)	+2	+2	+2	+1	+1	+1
Vertical Drain (630)	0	0	0	-1/+1	0	0
Waste Management System (312)	+2	+2	+2	+2	+1	+1
Waste Storage Pond (425)	+2	+2	+2	+2	+1	+1
Waste Storage Structure (313)	+2	+2	+2	+2	+1	+1
Waste Treatment Lagoon (359)	+2	+2	+2	+2	+1	+1
Waste Utilization (633)	+2	+2	+2	+2	+1	+2
Water and Sediment Control Basin (638)	0	0	-1	-2/+2	+2	+1
Well (Irrigation) (642i)	+1	+1	0	0	0	+1
Wetland Restoration (Interim) (657)	NA	NA	+1	+2	+2	+2
Wildlife Upland Habitat						

Conservation Practice/ (NRCS Code)	Soil Contaminants		Ground Water Contaminants	Surface Water Contaminants		Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Excess Fertilizers	Nutrients and Organics	Nutrients and Organics	Low Dissolved Oxygen	
Management (645)	**0**	**0**	**+1**	**+2**	**+2**	**+1**
Wildlife Wetland Habitat Management (644)	**NA**	**NA**	**+1**	**+2**	**+2**	**+2**
Windbreak/Shelterbelt Establishment Renovation (380)	**+1**	**+1**	**+1**	**+1**	**NA**	**+1**
Woodland Improved Harvest (Final) (654f)	**NA**	**NA**	**0**	**-1**	**-1**	**-1**
Woodland Improved Harvest (Intermediate Thin) (654i)	**NA**	**NA**	**0**	**-1**	**-1**	**-1**
Woodland Site Preparation (490)	**NA**	**NA**	**0**	**+/-**	**-1**	**-1**
~~**Woody Root Pruning (Interim) (747)**~~	~~**NA**~~	~~**NA**~~	~~**0**~~	~~**0**~~	~~**0**~~	~~**0**~~

THE FOLLOWING CONSERVATION PRACTICES ARE NOT APPLICABLE TO NUTRIENT MANAGEMENT AND NONPOINT SOURCE WATER QUALITY IMPACTS.

BRUSH MANAGEMENT (BIOLOGICAL) (314B)
BRUSH MANAGEMENT (CHEMICAL) (314C)
BRUSH MANAGEMENT (MECHANICAL) (314M)
BRUSH MANAGEMENT (BURNING) (314F)
PEST MANAGEMENT (MECHANICAL) (595M)
PIPELINE (516)
RECREATION AREA IMPROVEMENT (562)
RECREATION LAND GRADING AND SHAPING (566)

FIREBREAK (394)
TROUGH OR TANK (614)
FOREST STAND IMPROVEMENT (666)
OBSTRUCTION REMOVAL (500)
PEST MANAGEMENT (BIOLOGICAL) (595B)
PEST MANAGEMENT (CHEMICAL) (595C)

RECREATION TRAIL AND WALKWAY (568)

WELL (LIVESTOCK AND WILDLIFE) (642L)
WILDLIFE WATER FACILITY (648)
WOODLAND PRUNING (660)

TABLE 7: NONPOINT SOURCE WATER QUALITY IMPACTS DERIVED FROM PESTICIDE MANAGEMENT PRACTICES APPLIED ON AGRICULTURAL LANDS 11/03

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL CONTAMINANTS	GROUND WATER CONTAMINANTS	SURFACE WATER CONTAMINANTS	AQUATIC HABITAT SUITABILITY
	EXCESS PESTICIDES	PESTICIDES	PESTICIDES	
ACCESS ROAD (560)	0	+1	+1	+1
BRUSH MANAGEMENT (BIOLOGICAL) (314B)	NA	+2	+2	0
BRUSH MANAGEMENT (CHEMICAL) (314C)	NA	+/-	+/-	+/-
BRUSH MANAGEMENT (MECHANICAL) (314M)	NA	+1	+1	0
BRUSH MANAGEMENT (BURNING) (314F)	NA	0	0	0
CHISELING AND SUB-SOILING (324A)	+1	+1	+1	0
CHISELING AND SUB-SOILING (324B)	+1	+1	+1	0
CONSERVATION COVER (327)	+1	+1	+1	+1
CONSERVATION CROP ROTATION (328)	+2-	+1	+1	+1
CONTOUR BUFFER STRIP (332)	+1	+1	+1	+2
CONTOUR FARMING (330)	+1	+1	+1	0
COVER AND GREEN MANURE CROP (340)	+2	+1	+1	+1
CRITICAL AREA PLANTING (342)	+1	+1	+1	+1

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants	Surface Water Contaminants	Aquatic Habitat Suitability
	Excess Pesticides	Pesticides	Pesticides	
Cross Wind Ridges (589a)	+1	+1	+1	+1
Cross Wind Strip Crop (589b)	+1	+1	+2	+1
Cross Wind Trap Strip (589c)	+1	+1	+1	+1
Deferred Grazing (352)	+2	+2	+1	+1
Deep Tillage (Interim) (xxx)	+1	+1	+1	0
Dike (Earthen) (356)	0	0	+1	+1
Diversion (362)	0	-1	+1	0
~~**Farmstead and Evaluation (Interim) (752)**~~	~~+1~~	~~+1~~	~~+1~~	~~0~~
Field Border (386)	+1	NA	+1	+1
Filter Strip (393)	0	+1	+1	+2
Grade Stabilization Structure (410)	NA	0	0	0
Grassed Waterway (412)	0	0	+/-	0
Grasses and Legumes (Rotation) (411)	+1	+1	+1	+1
Herbaceous Wind Barriers (422a)	+1	+1	+1	+1
Irrigation Field Ditch (388)	+1	0	-1	0
Irrigation Land Leveling (464)	0	+1	+1	0

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants	Surface Water Contaminants	Aquatic Habitat Suitability
	Excess Pesticides	Pesticides	Pesticides	
Irrigation Pit or Regulating Reservoir (552)	+1	+1	+1	0
Irrigation System - Trickle (Micro) (441)	-1	+1	+1	0
Irrigation System - Sprinkler (442)	0	+1	+1	0
Irrigation System - Surface and Subsurface (443)	0	+1	+1	-1
Irrigation System -Tailwater Recovery (447)	-1	-1	+1	+1
Irrigation Water Conveyance - Ditch (428)	NA	0	0	0
Irrigation Water Conveyance - Pipeline (430)	NA	0	0	0
Irrigation Water Management (449)	+2	+2	+1	+1
Land Smoothing (466)	0	+1	+/-	0
Lined Waterway or Outlet (468)	0	0	0	0
Mulching (484)	+1	+1	+1	+1
Pasture and Hayland Management (510)	+1	0	+1	0
Pasture and Hayland Planting	+2	+1	+1	+1

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants	Surface Water Contaminants	Aquatic Habitat Suitability
	Excess Pesticides	Pesticides	Pesticides	
(512)				
Pest Management (Biological) (595b)	+2	+2	+2	0
Pest Management (Chemical) (595c)	+/-	+1	+2	NA
Pest Management (Mechanical) (595m)	+2	+2	+2	0
Planned Grazing System (556)	+1	+1	+1	-1
Pond (378)	NA	+/-	-1	0
Precision Land Forming (462)	0	+1	-1	0
Prescribed Burning (338)	+2	0	+1	-1
Proper Grazing Use (528)	+1	+1	+1	0
Pumping Plant for Water Control (533)	+1	+2	0	0
Residue management (No Till/ Strip) (329a)	+1	+1	+1	+1
Residue Management (Mulch Till) (329b)	+1	+1	+1	+1
Residue Management (Ridge Till) (329r)	+1	+1	+1	+1
Residue Management (Seasonal)				

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants	Surface Water Contaminants	Aquatic Habitat Suitability
	Excess Pesticides	Pesticides	Pesticides	
(344)	**+1**	**+1**	**+1**	**+1**
Riparian Forest Buffer (391)	**+1**	**+2**	**+2**	**+2**
Row Arrangement (557)	**+1**	**+1**	**+1**	**0**
Runoff Management System (570)	**NA**	**0**	**+1**	**0**
Sediment Basin (350)	**0**	**0**	**+1**	**0**
~~**Sinkhole Treatment (Interim) (725)**~~	~~**+1**~~	~~**+1**~~	~~**-1/+1**~~	~~**+1**~~
Streambank and Shoreline Protection (580)	**NA**	**0**	**+1**	**+1**
Stripcropping (Contour) (585)	**+1**	**+2**	**+2**	**+1**
Stripcropping (Field) (586)	**+1**	**+2**	**+2**	**+1**
Structure for Water Control (587)	**+1**	**+1**	**+1**	**+2**
Subsurface Drain (606)	**+1**	**+1**	**-1/+1**	**-1/-2**
Surface Drainage Field Ditch (607)	**0**	**0**	**-1**	**-1**
Surface Drainage Main or Lateral (608)	**0**	**0**	**-1**	**-1**
Surface Roughening (609)	**+1**	**+1**	**+1**	**0**
Terraces (Gradient) (600g)	**0**	**+/-**	**+1**	**0**

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants	Surface Water Contaminants	Aquatic Habitat Suitability
	Excess Pesticides	Pesticides	Pesticides	
Terraces (Storage) (600s)	**-1**	**+/-**	**+/-**	**0**
Underground Outlets (620) *	**-1**	**+/-**	**-1/-2**	**0**
Use Exclusion (472)	**+2**	**+2**	**+1**	**+1**
Vertical Drain (630)	**0**	**+/-**	**-1/-2**	**0**
Water and Sediment Control Basin (638)	**0**	**+/-**	**+1**	**+1**
Well (Irrigation) (642i)	**+1**	**0**	**0**	**+1**
Wetland Restoration (Interim) (657)	**NA**	**+1**	**+2**	**+1**
Wildlife Upland Habitat Management (645)	**0**	**+1**	**+2**	**+1**

THE FOLLOWING CONSERVATION PRACTICES DO NOT HAVE APPLICABILITY TO NONPOINT SOURCE WATER QUALITY IMPACTS RESULTING FROM PESTICIDE MANAGEMENT.

CLEARING AND SNAGGING (326)
COMMERCIAL FISHPONDS (397)
DAM, DIVERSION (348)
DAM, FLOODWATER RETARDING (402)
DAM, MULTIPLE PURPOSE (349)
FENCING (382)
FIELD WINDBREAK (392)
FIREBREAK (394)
FISHPOND MANAGEMENT (399)

FOREST STAND IMPROVEMENT (666)
HEAVY USE AREA PROTECTION (561)
HEDGEROW PLANTING (422)
IRRIGATION STORAGE RESERVOIR (436)

LAND RECONSTRUCTION (ABANDONED MINE LAND) (543)
LAND RECONSTRUCTION (CURRENT MINE LAND) (544)
NUTRIENT MANAGEMENT (DEFICIT) (590D)
NUTRIENT MANAGEMENT (EXCESS) (590E)
OBSTRUCTION REMOVAL (500)
OPEN CHANNEL (582)
PIPELINE (516)
POND SEALING OR LINING (521)
POULTRY COMPOSTING FACILITY (313A)

PROPER WOODLAND GRAZING (530)
RECREATION AREA IMPROVEMENT (562)
RECREATION LAND GRADING AND SHAPING (566)
RECREATION TRAIL AND WALKWAY (568)
SPOIL SPREADING (572)
SPRING DEVELOPMENT (574)
STREAM CHANNEL STABILIZATION (584)
TREE / SHRUB PLANTING (612)
TROUGH OR TANK (614)
WASTE MANAGEMENT SYSTEM (312)
WASTE STORAGE POND (425)
WASTE STORAGE STRUCTURE (313)
WASTE TREATMENT LAGOON (359)
WASTE UTILIZATION (633)
WELL (LIVESTOCK AND WILDLIFE) (642L)
WILDLIFE WATER FACILITY (648)
WINDBREAK/SHELTERBELT ESTABLISHMENT (380)

WOODLAND IMPROVED HARVEST (FINAL) (654F)

WOODLAND PRUNING (660)
WILDLIFE WETLAND HABITAT MANAGEMENT (644)
WOODLAND SITE PREPARATION (490)

Note: The Conservation Practice Effects for Underground Outlets (620) depends on where the tile outlets: directly into a stream or onto vegetation.

TABLE 8: NONPOINT SOURCE WATER QUALITY IMPACTS DERIVED FROM IRRIGATION MANAGEMENT PRACTICES APPLIED TO AGRICULTURAL LANDS (12/28/98)

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL TILTH, CRUSTING, WATER INFILTRATION, ORGANIC MATERIALS	SOIL COMPACTION	SOIL CONTAMINANTS	GROUNDWATER CONTAMINANTS		SURFACE WATER CONTAMINANTS		SUSPENDED SEDIMENT AND TURBIDITY	WATER MANAGEMENT IRRIGATED LANDS
			EXCESS ANIMAL MANURES AND OTHER ORGANICS	NUTRIENTS AND ORGANICS	PESTICIDES	NUTRIENTS AND ORGANICS	PESTICIDES		
ACCESS ROAD (560)	NA	+1	+2	+1	+1	+1	+1	+1	+1
CHISELING AND SUB-SOILING (324A)	+1	+1	+1	+1	+1	+1	+1	+1	0
CHISELING AND SUB-SOILING (324B)	+1	+1	+1	+1	+1	+1	+1	+1	0
CONSERVATION COVER (327)	+1	+1	+1	+1	+1	+1	+1	+1	0
CONSERVATION CROP ROTATION (328)	+2	+2	+1	+1	+1	+1	+1	+1	+1
COVER AND GREEN MANURE CROP (340)	+2	+2	+1	+1	+1	+1	+1	+1	+1
CRITICAL AREA PLANTING (342)	+2	+2	+1	+1	+1	+1	+1	+1	+1
CROSS WIND RIDGES (589A)	+1	+1	+1	+1	+1	+1	+2	+1	+1
CROSS WIND STRIP CROP (589B)	+2	+1	+1	+1	+1	+1	+1	+1	+1
CROSS WIND TRAP STRIP (589C)	+1	+1	+1	+1	+1	+1	+1	+1	+1

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants	Groundwater Contaminants		Surface Water Contaminants		Suspended Sediment and Turbidity	Water Management Irrigated Lands
			Excess Animal Manures and Other Organics	Nutrients and organics	Pesticides	Nutrients and Organics	Pesticides		
Deep Tillage (Interim) (xxx)	+1	+1	+1	+1	+1	+1	+1	+1	+1
Dike (Earthen) (356)	0	0	0	0	0	+1	+1	+1	NA
Diversion (362)	0	0	-1	-1	-1	+1	+1	+1	+2
Field Border (386)	+1	+1	NA	NA	NA	+1	+1	0	NA
Field Windbreak (392)	0	0	+1	+1	+1	+1	+1	+1	+1
Filter Strip (393)	0	0	+1	+1	+1	+1	+1	+2	NA
Grade Stabilization Structure (410)	NA	NA	0	0	0	+1	+1	+1	NA
Grassed Waterway (412)	0	0	0	-1	0	+1	+1	+1	NA
Grasses and Legumes (Rotation) (411)	+2	+2	+2	+2	+2	+2	+2	+2	+2
Heavy Use Area Protection (561)	+1	+1	0	0	0	+1	+1	+2	NA
Hedgerow Planting (422)	0	+1	+1	+1	+1	+1	+1	+1	+1
Herbaceous Wind Barriers (422a)	+1	+1	+1	+1	+1	+1	+1	+1	+1
Irrigation Field Ditch (388)	0	0	0	0	0	-1	-1	0	+/-

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants	Groundwater Contaminants		Surface Water Contaminants		Suspended Sediment and Turbidity	Water Management Irrigated Lands
			Excess Animal Manures and Other Organics	Nutrients and organics	Pesticides	Nutrients and Organics	Pesticides		
Irrigation Land Leveling (464)	**0**	**+/-**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+2**
Irrigation Pit or Regulating Reservoir (552)	**0**	**0**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+2**
Irrigation Storage Reservoir (436)	**0**	**0**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+2**
Irrigation System - Trickle (Micro) (441)	**+1**	**+1**	**+2**	**+2**	**+2**	**+2**	**+1**	**+1**	**+1**
Irrigation System – Sprinkler (442)	**-1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+2**	**-2**
Irrigation System – Surface and Subsurface (443)	**0**	**-2**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**
Irrigation System -Tail Water Recovery (447)	**0**	**0**	**-1**	**-1**	**-1**	**+/-**	**+/-**	**+1**	**+1**
Irrigation Water Conveyance - Ditch (428)	**0**	**NA**	**NA**	**0**	**0**	**0**	**0**	**0**	**NA**
Irrigation Water Conveyance - Pipeline (430)	**0**	**NA**	**NA**	**0**	**0**	**0**	**0**	**0**	**NA**
Irrigation Water Management (449)	**+2**	**+1**	**+2**	**+2**	**+2**	**+2**	**+2**	**+2**	**+2**

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants	Groundwater Contaminants		Surface Water Contaminants		Suspended Sediment and Turbidity	Water Management Irrigated Lands
			Excess Animal Manures and Other Organics	Nutrients and organics	Pesticides	Nutrients and Organics	Pesticides		
Land Smoothing (466)	0	0	+1	+1	-1	-1/+1	-1/+1	-1/+1	+1
Lined Waterway or Outlet (468)	NA	NA	0	0	0	0	0	0	0
Nutrient Management (Deficit) (590d)	+1	NA	NA	+1	NA	+1	NA	0	+1
Nutrient Management (Excess) (590e)	+1	NA	+2	+2	NA	+2	NA	+1	+1
Obstruction Removal (500)	0	0	0	0	0	0	0	0	0
Open Channel (582)	NA	NA	0	0	0	0	0	0	NA
Pest Management (Biological) (595b)	NA	NA	NA	NA	+1	NA	+1	0	NA
Pest Management (Chemical) (595c)	NA	NA	NA	NA	+1	NA	+1	0	NA
Pest Management (Mechanical) (595m)	NA	NA	NA	NA	+1	NA	+1	0	NA
Pipeline (516)	0	0	NA	NA	NA	NA	NA	NA	NA
Pond (378)	NA	0	NA	+/-	+/-	-1	-1	0	NA
Pond Sealing or Lining (521)	+1	+1	NA	+1	+1	0	0	0	+1
Precision Land Forming (462)	0	0	+1	+1	+1	+/-	+/-	0	+1

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants	Groundwater Contaminants		Surface Water Contaminants		Suspended Sediment and Turbidity	Water Management Irrigated Lands
			Excess Animal Manures and Other Organics	Nutrients and organics	Pesticides	Nutrients and Organics	Pesticides		
Pumping Plant for Water Control (533)	0	0	+2	+2	+2	0	0	0	+1
Residue management (No Till/ Strip) (329a)	+2	+2	+1	+1	+1	+1	+1	+1	+1
Residue Management (Mulch Till) (329b)	+2	+1	+1	+1	+1	+1	+1	+1	+2
Residue Management (Ridge Till) (329r)	+2	+1	+1	+1	+1	+1	+1	+1	+1
Residue Management (Seasonal) (344)	+2	+1	+1	+1	+1	+1	+1	+1	+1
Riparian Forest Buffer (391)	+1	+1	+2	+2	+2	+2	+2	+2	NA
Row Arrangement (557)	+1	+2	+1	+2	0	+2	+1	+1	+1
Runoff Management System (570)	+1	-1	0	0	0	+1	+1	+2	+1
Sediment Basin (350)	0	0	0	0	0	+1	+1	+2	0
Stream Bank and Shoreline Protection (580)	0	0	0	0	0	+1	+1	+1	NA
Stream Channel Stabilization (584)	0	0	0	0	0	+1	+1	+1	0
Strip Cropping (Field)									

Conservation Practice/ (NRCS Code)	**Soil Tilth, Crusting, Water Infiltration, Organic Materials**	**Soil Compaction**	**Soil Contaminants**	**Groundwater Contaminants**		**Surface Water Contaminants**		**Suspended Sediment and Turbidity**	**Water Management Irrigated Lands**
			Excess Animal Manures and Other Organics	**Nutrients and organics**	**Pesticides**	**Nutrients and Organics**	**Pesticides**		
(586)	**+2**	**+1**	**+2**	**+2**	**+2**	**+2**	**+2**	**+1**	**0**
Structure for Water Control (587)	**0**	**+1**	**+1**	**-1**	**+1**	**+1**	**+1**	**0**	**+1**
Subsurface Drain (606)	**+1**	**+1**	**+1**	**+1**	**+1**	**-1/+1**	**-1/+1**	**+1**	**+1**
Surface Drainage Field Ditch (607)	**+1**	**+1**	**0**	**0**	**0**	**-1**	**-1**	**-1**	**+1**
Surface Drainage Main or Lateral (608)	**+1**	**+1**	**0**	**0**	**0**	**-1**	**-1**	**-1**	**+1**
Surface Roughening (609)	**0**	**0**	**0**	**0**	**0**	**+1**	**+1**	**+1**	**0**
Underground Outlets (620) *	**NA**	**NA**	**0**	**0**	**0**	**-1/+1**	**-1/+1**	**+1**	**NA**
Vertical Drain (630)	**0**	**0**	**0**	**0**	**0**	**-1/+1**	**-1/+1**	**+1**	**NA**
Waste Management System (312)	**+1**	**NA**	**+2**	**+2**	**NA**	**+2**	**NA**	**+1**	**+1**
Waste Storage Pond (425)	**NA**	**NA**	**+2**	**+2**	**NA**	**+2**	**NA**	**+2**	**NA**
Waste Storage Structure (313)	**NA**	**NA**	**+2**	**+2**	**NA**	**+2**	**NA**	**+1**	**NA**
Waste Treatment	**NA**	**NA**	**+2**	**+2**	**NA**	**+2**	**NA**	**+1**	**+1**

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Compaction	Soil Contaminants	Groundwater Contaminants		Surface Water Contaminants		Suspended Sediment and Turbidity	Water Management Irrigated Lands
			Excess Animal Manures and Other Organics	Nutrients and organics	Pesticides	Nutrients and Organics	Pesticides		
Lagoon (359)									
Waste Utilization (633)	+1	NA	+2	+2	NA	+2	NA	+1	+1
Well (Irrigation) (642i)	0	+1	0	0	0	0	0	0	+1
Wildlife Upland Habitat Management (645)	+2	+2	+1	+1	+1	+2	+2	+2	NA
Wildlife Wetland Habitat Management (644)	NA	NA	+1	+1	+1	+2	+2	+2	+1

THE FOLLOWING CONSERVATION PRACTICES DO NOT HAVE APPLICABILITY TO NONPOINT SOURCE WATER QUALITY IMPACTS RESULTING FROM IRRIGATION MANAGEMENT.

BRUSH MANAGEMENT (BIOLOGICAL) (314B)
BRUSH MANAGEMENT (CHEMICAL) (314C)
BRUSH MANAGEMENT (MECHANICAL) (314M)
BRUSH MANAGEMENT (BURNING) (314F)
CLEARING AND SNAGGING (326)
COMMERCIAL FISH PONDS (397)
CONTOUR BUFFER STRIP (332)
CONTOUR FARMING (330)
DAM, DIVERSION (348)
DAM, FLOODWATER RETARDING (402)
DAM, MULTIPLE PURPOSE (349)
DEFERRED GRAZING (352)

FENCING (382)
FIREBREAK (394)
FISHPOND MANAGEMENT (399)

FOREST STAND IMPROVEMENT (666)

LAND RECONSTRUCTION (ABANDONED MINE LAND) (543)
LAND RECONSTRUCTION (CURRENT MINE LAND) (544)
MULCHING (484)
PASTURE AND HAYLAND MANAGEMENT (510)
PASTURE AND HAYLAND PLANTING (512)
PLANNED GRAZING SYSTEM (556)
POULTRY COMPOSTING FACILITY (313A)
PRESCRIBED BURNING (338)
PROPER GRAZING USE (528)
PROPER WOODLAND GRAZING (530)
RECREATION AREA IMPROVEMENT (562)
RECREATION LAND GRADING AND SHAPING (566)
RECREATION TRAIL AND WALKWAY (568)
SPOIL SPREADING (572)
SPRING DEVELOPMENT (574)

STRIP CROPPING (CONTOUR) (585)
TERRACES (GRADIENT) (600G)
TERRACES (STORAGE) (600S)
TREE/SHRUB PLANTING (612)
TROUGH OR TANK (614)
USE EXCLUSION (472)
WATER AND SEDIMENT CONTROL BASIN (638)
WELL (LIVESTOCK AND WILDLIFE) (642L)
WETLAND RESTORATION (INTERIM) (657)
WILDLIFE WATER FACILITY (648)
WINDBREAK/SHELTERBELT ESTABLISHMENT (380)

WOODLAND IMPROVED HARVEST (FINAL) (654F)

WOODLAND PRUNING (660)
WOODLAND SITE PREPARATION (490)

Note: The Conservation Practice Effects for Underground Outlets (620) depends on where the tile outlets: directly into a stream or onto vegetation.

TABLE 9: NONPOINT SOURCE WATER QUALITY IMPACTS DERIVED FROM MANURE MANAGEMENT PRACTICES APPLIED TO AGRICULTURAL LANDS (11/03)

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL CONTAMINANTS	GROUND WATER CONTAMINANTS		SURFACE WATER CONTAMINANTS			SUSPENDED SEDIMENT AND TURBIDITY	AQUATIC HABITAT SUITABILITY
	EXCESS ANIMAL MANURES AND OTHER ORGANICS	NUTRIENTS AND ORGANICS	PATHOGENS	NUTRIENTS AND ORGANICS	LOW DISSOLVED OXYGEN	PATHOGENS		
ACCESS ROAD (560)	+2	+1	0	+1	0	0	+1	+1
CHISELING AND SUB-SOILING (324A)	+/-	-1	0	+1	+1	0	+1	+1
CHISELING AND SUB-SOILING (324B)	+/-	-1	0	+1	+1	0	+1	+1
COMMERCIAL FISH PONDS (397)	+1	+2	0	+1	+1	0	+1	+1
CONSERVATION COVER (327)	+2	+2	+1	+2	+1	0	+1	+1
CONSERVATION CROP ROTATION (328)	+1	+1	+1	+1	+1	0	+1	+1
CONTOUR BUFFER STRIP (332)	+1	+1	+1	+2	+1	+2	+2	+2
CONTOUR FARMING (330)	+1	+1	0	+1	0	0	+1	0
COVER AND GREEN MANURE CROP (340)	+2	+1	0	+1	0	0	+1	+1
CRITICAL AREA PLANTING (342)	+1	+1	NA	+1	+1	0	+2	+1
CROSS WIND RIDGES (589A)	+1	+1	0	+2	+1	0	+1	+2
CROSS WIND STRIP CROP (589A)	+1	+1	0	+1	+1	0	+1	+1

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
Cross Wind Trap Strip (589c)	+1	+1	0	+1	+1	0	+1	+1
Dam, Diversion (348)	0	0	0	+1	+1	0	+1	0
Dam, Floodwater Retarding (402)	0	+1	+1	+1	+1	+1	+1	+1
Dam, Multiple Purpose (349)	0	0	0	+1	+1	+1	+1	+1
Deferred Grazing (352)	+2	+2	+1	0	+1	0	+1	+1
Deep Tillage (Interim) (xxx)	+1	+1	-2	0	+1	0	+1	NA
Dike (Earthen) (356)	0	0	+1	0	+1	+1	+1	+1
Diversion (362)	0	0	0	+/-	+1	+1	+1	0
Field Border (386)	+1	+1	+1	+1	+1	+1	0	+1
Field Windbreak (392)	+1	+1	0	+1	+1	0	0	+1
Filter Strip (393)	0	+1	0	+1	+1	0	+2	+2
Fishpond Management (399)	NA	-1	0	-1	-1	0	+1	+2
Grade Stabilization Structure (410)	0	0	0	0	0	0	+1	0
Grassed Waterway (412)	0	0	0	+1	0	0	+1	0
Grasses and Legumes (Rotation) (411)	+2	+2	+1	+1	+1	+1	+2	+1
Heavy Use Area Protection								

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
(561)	**NA**	**+1**	**+1**	**+1**	**+1**	**+1**	**+2**	**+1**
Hedgerow Planting (422)	**+1**	**+1**	**+1**	**+1**	**0**	**NA**	**+1**	**+1**
Herbaceous Wind Barriers (422a)	**+1**	**0**	**0**	**+1**	**+1**	**0**	**1+**	**+1**
Irrigation Field Ditch (388)	**+1**	**0**	**0**	**-1**	**0**	**0**	**0**	**0**
Irrigation Land Leveling (464)	**0**	**+1**	**-1**	**+1**	**+1**	**-1**	**+1**	**0**
Irrigation Pit or Regulating Reservoir (552)	**+1**	**+1**	**+1**	**+1**	**+1**	**0**	**+1a**	**0**
Irrigation Storage Reservoir (436)	**+1**	**+1**	**+1**	**+1**	**+1**	**0**	**+1**	**0**
Irrigation System - Trickle (Micro) (441)	**-1**	**+1**	**+1**	**+1**	**+1**	**+1**	**+1**	**0**
Irrigation System - Sprinkler (442)	**0**	**+1**	**0**	**+1**	**+1**	**-1**	**+2**	**0**
Irrigation System - Surface and Subsurface (443)	**0**	**+1**	**0**	**+1**	**+1**	**+1**	**+1**	**-1**
Irrigation System - Tail Water Recovery (447)	**-1**	**-1**	**-1**	**+1**	**+1**	**+1**	**+1**	**+1**
Irrigation Water Conveyance - Ditch (428)	**NA**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
Irrigation Water Conveyance - Pipeline (430)	NA	0	0	0	0	0	0	0
Irrigation Water Management (449)	+2	+2	+2	+1	+1	+1	+1	+1
~~Land Clearing (Woodland) (460)~~	~~0~~	~~0~~	~~NA~~	~~0~~	~~0~~	~~NA~~	~~-1~~	~~-1~~
Land Reconstruction (Abandoned Mine Land) (543)	NA	0	0	+1	0	+1	0	0
Land Reconstruction (Current Mine Land) (544)	NA	0	0	0	+1	0	+1	+1
Land Smoothing (466)	+1	+1	+1	+/-	+/-	+/-	0	0
Lined Waterway or Outlet (468)	0	0	0	0	0	0	0	0
Mulching (484)	+1	+1	0	+1	+1	0	+1	+1
Nutrient Management (Deficit) (590d)	+2	+2	+/-	+2	+1	+1	+1	+1
Nutrient Management (Excess) (590e)	+2	+2	+/-	+2	+1	+1	+1	+1
Open Channel (582)	NA	0	0	0	+1	0	0	-1
Pasture and Hayland Management (510)	+1	+1	+1	+1	+1	+1	+1	0

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
Pasture and Hayland Planting (512)	+1	+1	0	+1	+1	0	+1	+1
Precision Land Forming (462)	+1	+1	+1	+/-	+/-	+/-	0	0
Planned Grazing System (556)	+1	+1	+/-	+1	+1	+/-	+1	+1
Pond (378)	NA	+/-	+/-	0	0	0	0	0
Pond Sealing or Lining (521)	0	+/-	0	0	0	0	0	0
Poultry Composting Facility (313A)	+2	+2	+1	+1	+1	+1	+1	+1
Proper Grazing Use (528)	+2	+/-	0	+1	+1	0	0	+1
Pumping Plant for Water Control (533)	+1	+1	0	+1	0	0	0	0
Residue management (No Till/ Strip) (329A)	+1	+1	+1	+1	+1	+1	+1	+1
Residue Management (Mulch Till) (329B)	+1	+1	+1	+1	+1	+1	+1	+1
Residue Management (Ridge Till) (329R)	+1	+1	+1	+1	+1	+1	+1	+1
Residue Management (Seasonal) (344)	+1	+1	+/-	+1	+1	+1	+1	+1
Riparian Forest Buffer (391)	+1	+2	+1	+2	+2	+1	+2	+2

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL CONTAMINANTS	GROUND WATER CONTAMINANTS		SURFACE WATER CONTAMINANTS			SUSPENDED SEDIMENT AND TURBIDITY	AQUATIC HABITAT SUITABILITY
	EXCESS ANIMAL MANURES AND OTHER ORGANICS	NUTRIENTS AND ORGANICS	PATHOGENS	NUTRIENTS AND ORGANICS	LOW DISSOLVED OXYGEN	PATHOGENS		
ROW ARRANGEMENT (557)	+1	+1	0	+1	+1	0	+1	+1
RUNOFF MANAGEMENT SYSTEM (570)	NA	0	0	+1	+/-	+/-	+2	0
SEDIMENT BASIN (350)	0	-1	0	+2	+1	0	+2	+2
STRIP CROPPING (CONTOUR) (585)	+1	+2	0	+2	+1	0	+1	+1
STRIP CROPPING (FIELD) (586)	+1	+2	0	+2	+1	0	+1	+1
STRUCTURE FOR WATER CONTROL (587)	+1	-1	0	+1	+1	0	0	+2
SUBSURFACE DRAIN (606)	+1	+1	+1	-2	-1/+1	-1/+1	+1	-1/-2
SURFACE DRAINAGE FIELD DITCH (607)	+1	+/-	+/-	-1	-1	+/-	-1	-1
SURFACE DRAINAGE MAIN OR LATERAL (608)	+1	+/-	+/-	-1	-1	+/-	-1	-1
SURFACE ROUGHENING (609)	0	0	0	+2	+1	0	+1	+1
TERRACES (GRADIENT) (600G)	+1	0	0	+1	+1	+/-	+1	0
TERRACES (STORAGE) (600S)	+1	0	0	+/-	+/-	+/-	+1	0
UNDERGROUND OUTLETS (620) *	0	0	0	-1/+1	+1	-1/+1	+1	+1
USE EXCLUSION (472)	+2	+2	0	+2	+2	0	+1	+2

Conservation Practice/ (NRCS Code)	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
	Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
Vertical Drain (630)	**0**	**0**	**0**	**-1/+1**	**+/-**	**-1/+1**	**+1**	**0**
Waste Management System (312)	**+2**	**+2**	**+/-**	**+2**	**+1**	**+1**	**+1**	**+1**
Waste Storage Pond (425)	**+2**	**+2**	**+/-**	**+2**	**+1**	**+/-**	**+1**	**+1**
Waste Storage Structure (313)	**+2**	**+2**	**+/-**	**+2**	**+1**	**+/-**	**+1**	**+1**
Waste Treatment Lagoon (359)	**+2**	**+2**	**+/-**	**+2**	**+1**		**+1**	**+1**
Waste Utilization (633)	**+2**	**+2**	**+/-**	**+2**	**+1**	**+1**	**+1**	**+1**
Water and Sediment Control Basin (638)	**0**	**0**	**+/-**	**+1**	**+1**	**+/-**	**+2**	**+1**
Wetland Restoration (Interim) (657)	**NA**	**+1**	**+1**	**+2**	**+2**	**+1**	**+2**	**+2**
Wildlife Wetland Habitat Management (644)	**NA**	**+1**	**+1**	**+2**	**+2**	**+1**	**+2**	**+2**
Windbreak/Shelterbelt Establishment (380)	**+1**	**+1**	**+1**	**+1**	**NA**	**NA**	**+1**	**+1**

THE FOLLOWING CONSERVATION PRACTICES DO NOT HAVE APPLICABILITY TO NONPOINT SOURCE WATER QUALITY IMPACTS RESULTING FROM MANURE MANAGEMENT.

BRUSH MANAGEMENT (BIOLOGICAL) (314B)
BRUSH MANAGEMENT (CHEMICAL) (314C)
BRUSH MANAGEMENT (MECHANICAL) (314M)
BRUSH MANAGEMENT (BURNING) (314F)
Clearing and Snagging (326)
Fencing (382)
Firebreak (394)

Forest Stand Improvement (666)
Obstruction Removal (500)
Pest Management (Biological) (595b)
Pest Management (Chemical) (595c)
Pest Management (Mechanical) (595m)
Pipeline (516)
Prescribed Burning (338)
Proper Woodland Grazing (530)
RECREATION AREA IMPROVEMENT (562)
RECREATION LAND GRADING AND SHAPING (566)

RECREATION TRAIL AND WALKWAY (568)
SPOIL SPREADING (572)
SPRING DEVELOPMENT (574)
STREAM BANK AND SHORELINE PROTECTION (580)
STREAM CHANNEL STABILIZATION (584)
TREE / SHRUB PLANTING (612)
TROUGH OR TANK (614)
WELL (IRRIGATION) (642I)
WELL (LIVESTOCK AND WILDLIFE) (642L)
WILDLIFE UPLAND HABITAT MANAGEMENT (645)
WILDLIFE WATER FACILITY (648)

WOODLAND IMPROVED HARVEST (FINAL) (654F)

WOODLAND PRUNING (660)
WOODLAND SITE PREPARATION (490)

Note: The Conservation Practice Effects for Underground Outlets (620) depends on where the tile outlets: directly into a stream or onto vegetation.

TABLE 10: NONPOINT SOURCE WATER QUALITY IMPACTS DERIVED FROM PASTURE MANAGEMENT PRACTICES APPLIED TO AGRICULTURAL LANDS (11/03)

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL TILTH, CRUSTING, WATER INFILTRATION, ORGANIC MATERIALS	SOIL CONTAMINANTS	GROUND WATER CONTAMINANTS		SURFACE WATER CONTAMINANTS			SUSPENDED SEDIMENT AND TURBIDITY	AQUATIC HABITAT SUITABILITY
		EXCESS ANIMAL MANURES AND OTHER ORGANICS	NUTRIENTS AND ORGANICS	PATHOGENS	NUTRIENTS AND ORGANICS	LOW DISSOLVED OXYGEN	PATHOGENS		
ACCESS ROAD (560)	NA	0	+1	NA	+1	0	NA	+1	+1
BRUSH MANAGEMENT (BIOLOGICAL) (314B)	+1	NA	+/-	NA	+/-	0	NA	0	0
BRUSH MANAGEMENT (CHEMICAL) (314C)	+1	NA	+/-	NA	+/-	0	NA	0	0
BRUSH MANAGEMENT (MECHANICAL) (314M)	+/-	NA	+/-	NA	+/-	-1	NA	-1	0
BRUSH MANAGEMENT (BURNING) (314F)	+1	NA	+/-	NA	+/-	-1	NA	-1	0
CONSERVATION COVER (327)	+1	+1	+1	0	+1	+1	0	+1	+1
CONTOUR BUFFER STRIP (332)	NA-	+1	+1	+1	+2	+2	+2	+2	+2
CRITICAL AREA PLANTING (342)	+2	+1	+1	0	+1	+1	0	+1	+1
DEFERRED GRAZING (352)	+2	+2	+2	0	+1	+1	0	+1	+1
DIKE (EARTHEN) (356)	0	0	0	0	+1	+1	+1	+1	+1
DIVERSION (362)	0	0	-1	0	+1	+1	+1	+1	0
FENCING (382)	+1	+1	+1	0	+1	+1	+1	+1	+1
F IELD BORDER (386)	+1	+1	NA	NA	+1	NA	NA	0	+1

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
		Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
Field Windbreak (392)	+1	NA	+1	0	+1	0	0	+1	0
Filter Strip (393)	0	0	+1	0	+1	+1	0	+2	+2
Grade Stabilization Structure (410)	NA	NA	0	0	0	0	0	+1	0
Grassed Waterway (412)	0	0	0	0	+1	0	0	+1	0
Grasses and Legumes (Rotation) (411)	+2	+1	+2	+1	+2	+1	+1	+2	+1
Heavy Use Area Protection (561)	+1	NA	0	0	+1	+1	+1	+2	+1
Land Reconstruction (Abandoned Mine Land) (543)	+1	NA	0	0	+1	0	+1	+1	+1
Land Reconstruction (Current Mine Land) (544)	+1	NA	0	0	0	+1	0	+1	+1
Lined Waterway or Outlet (468)	NA	0	0	0	0	0	0	0	0
Nutrient Management (Deficit) (590d)	+1	+2	+2	NA	+2	+1	NA	+1	+1
Nutrient Management (Excess) (590e)	+1	+2	+2	NA	+2	+1	NA	+1	+1
Pasture and Hayland Management (510)	+2	+1	+1	+/-	+1	+1	+/-	+1	+1
Pasture and Hayland Planting	+2	+2	+1	+1	+1	+1	+/-	+1	0

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
		Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
(512)									
Pest Management (Biological) (595b)	NA	NA	NA	NA	NA	NA	NA	+2	+2
Pest Management (Chemical) (595c)	NA	NA	NA	NA	NA	NA	NA	+/-	0
Pest Management (Mechanical) (595m)	NA	NA	NA	NA	NA	NA	NA	-1	+/-
Pipeline (516)	0	NA	NA	NA	NA	NA	NA	+1	+1
Planned Grazing System (556)	+1	+1	+/-	+/-	+1	+1	+/-	+1	+1
Pond (378)	NA	NA	+/-	+/-	0	0	0	0	+/-
Pond Sealing or Lining (521)	+1	0	+1	0	0	0	0	0	0
Prescribed Burning (338)	NA	0	0	0	-1	-1	+1	-1	-1
Proper Grazing Use (528)	0	+1	+/-	+/-	+1	+1	+/-	+1	+1
Proper Woodland Grazing (530)	0	+1	+/-	0	+/-	+/-	+/-	+/-	0
Residue Management (No Till/ Strip) (329a)	+/-	+1	+1	0	+1	+1	0	+1	+1
Residue Management (Mulch Till) (329b)	+/-	+1	+1	0	+1	+1	0	+1	+1
Residue Management (Ridge	+/-	+1	+1	0	+1	+1	0	+1	+1

Conservation Practice/ (NRCS Code)	Soil Tilth, Crusting, Water Infiltration, Organic Materials	Soil Contaminants	Ground Water Contaminants		Surface Water Contaminants			Suspended Sediment and Turbidity	Aquatic Habitat Suitability
		Excess Animal Manures and Other Organics	Nutrients and Organics	Pathogens	Nutrients and Organics	Low Dissolved Oxygen	Pathogens		
Till) (329r)									
Residue Management (Seasonal) (344)	**+/-**	**+1**	**+1**	**0**	**+1**	**+1**	**0**	**+1**	**+1**
Riparian Forest Buffer (391)	**+1**	**+1**	**+2**	**+1**	**+2**	**+2**	**+1**	**+2**	**+2**
Runoff Management System (570)	**+1**	**NA**	**+/-**	**+/-**	**+1**	**+/-**	**+/-**	**+2**	**0**
Sediment Basin (350)	**0**	**+/-**	**0**	**0**	**+1**	**+1**	**-1**	**+2**	**0**
Spring Development (574)	**0**	**0**	**+1**	**+1**	**+1**	**0**	**+1**	**+1**	**0**
Stream Bank and Shoreline Protection (580)	**0**	**+1**	**0**	**0**	**+1**	**+1**	**+1**	**+2**	**+2**
Stream Channel Stabilization (584)	**0**	**0**	**0**	**0**	**+2**	**+1**	**+1**	**+2**	**+2**
Surface Drainage Field Ditch (607)	**+1**	**+1**	**0**	**0**	**-1**	**-1**	**-1**	**-1**	**-1**
Surface Drainage Main or Lateral (608)	**+1**	**+1**	**0**	**0**	**-1**	**-1**	**-1**	**-1**	**-1**
Trough or Tank (614)	**+1**	**+1**	**+1**	**+/-**	**+1**	**0**	**+1**	**+2**	**+2**
Use Exclusion (472)	**+2**	**+1**	**-1**	**+1**	**+2**	**+2**	**+2**	**+1**	**+2**
Waste Utilization (633)	**+2**	**+2**	**+1**	**0**	**+1**	**0**	**0**	**+1**	**+1**
Well (Livestock and Wildlife)	**+1**	**+1**	**+1**	**0**	**+1**	**0**	**0**	**+2**	**+2**

CONSERVATION PRACTICE/ (NRCS CODE)	SOIL TILTH, CRUSTING, WATER INFILTRATION, ORGANIC MATERIALS	SOIL CONTAMINANTS	GROUND WATER CONTAMINANTS		SURFACE WATER CONTAMINANTS			SUSPENDED SEDIMENT AND TURBIDITY	AQUATIC HABITAT SUITABILITY
		EXCESS ANIMAL MANURES AND OTHER ORGANICS	NUTRIENTS AND ORGANICS	PATHOGENS	NUTRIENTS AND ORGANICS	LOW DISSOLVED OXYGEN	PATHOGENS		
(642L)									
WETLAND RESTORATION (INTERIM) (657)	NA	NA	+1	+1	+2	+2	+1	+2	+2
WILDLIFE UPLAND HABITAT MANAGEMENT (645)	+/-	0	+1	0	+1	0	0	+2	+1
WILDLIFE WATER FACILITY (648)	+1	+1	+1	+/-	+1	0	+/-	+2	+2
WILDLIFE WETLAND HABITAT MANAGEMENT (644)	NA	NA	+1	+1	+2	+2	+1	+2	+2
WINDBREAK/SHELTERBELT ESTABLISHMENT (380)	+2	0	+/-	0	+/-	0	0	0	0

THE FOLLOWING CONSERVATION PRACTICES DO NOT HAVE APPLICABILITY TO NONPOINT SOURCE WATER QUALITY RESULTING FROM PASTURE MANAGEMENT.

CHISELING AND SUB-SOILING (324A)
CHISELING AND SUB-SOILING (324B)
CLEARING AND SNAGGING (326)
COMMERCIAL FISH PONDS (397)
CONSERVATION CROP ROTATION (328)
CONTOUR FARMING (330)
COVER AND GREEN MANURE CROP (340)
CROSS WIND RIDGES (589A)
CROSS WIND STRIP CROP (589B)
CROSS WIND TRAP STRIP (589C)
DAM, DIVERSION (348)
DAM, FLOODWATER RETARDING (402)
DAM, MULTIPLE PURPOSE (349)
DEEP TILLAGE (INTERIM) (XXX)
FIREBREAK (394)
FISHPOND MANAGEMENT (399)

FOREST STAND IMPROVEMENT (666)
HEDGEROW PLANTING (422)
HERBACEOUS WIND BARRIERS (422A)
IRRIGATION FIELD DITCH (388)
IRRIGATION LAND LEVELING (464)
IRRIGATION PIT OR REGULATING RESERVOIR (552)
IRRIGATION STORAGE RESERVOIR (436)
IRRIGATION SYSTEM - TRICKLE (MICRO) (441)
IRRIGATION SYSTEM - SPRINKLER (442)
IRRIGATION SYSTEM - SURFACE AND SUBSURFACE (443)
IRRIGATION SYSTEM -TAIL WATER RECOVERY (447)
IRRIGATION WATER CONVEYANCE - DITCH (428)
IRRIGATION WATER MANAGEMENT (449)
LAND SMOOTHING (466)
MULCHING (484)

OBSTRUCTION REMOVAL (500)
OPEN CHANNEL (582)
PRECISION LAND FORMING (462)
POULTRY COMPOSTING FACILITY (313A)
PUMPING PLANT FOR WATER CONTROL (533)
RECREATION AREA IMPROVEMENT (562)
RECREATION LAND GRADING AND SHAPING (566)
RECREATION TRAIL AND WALKWAY (568)
ROW ARRANGEMENT (557)
SPOIL SPREADING (572)
STRIP CROPPING (CONTOUR) (585)
STRIP CROPPING (FIELD) (586)
STRUCTURE FOR WATER CONTROL (587)
SUBSURFACE DRAIN (606)
SURFACE ROUGHENING (609)
TERRACES (GRADIENT) (600G)
TERRACES (STORAGE) (600S)
UNDERGROUND OUTLETS (620)
VERTICAL DRAIN (630)
WASTE MANAGEMENT SYSTEM (312)
WASTE STORAGE POND (425)
WASTE STORAGE STRUCTURE (313)
WASTE TREATMENT LAGOON (359)
WATER AND SEDIMENT CONTROL BASIN (638)
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AGRICULTURAL CONSERVATION PRACTICES FOR WATER QUALITY
11/2003

Access Road (560)

A travel way constructed as part of a conservation plan. It applies to roads constructed to provide access to farms, ranches, fields, conservation systems, structures, and recreational areas; to transport equipment or supplies; to operate and maintain the conservation enterprise.

Brush Management (314)

Removal, reduction, or manipulation of excessive non-herbaceous plants on rangeland, native or naturalized pasture lands is desired to maintain a diversity of vegetation for forage production. This practice is applied as part of a Conservation Management System to accomplish one or more of the following purposes. It can be used to restore the natural plant community balance; create the desired plant community; reduce competition for space, moisture, and sunlight between desired and unwanted plants; manage noxious woody plants; restore desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality and enhance stream flow; maintain or enhance wildlife habitat including that associated with threatened and endangered species; improve forage accessibility, quality and quantity for livestock; protect life and property from wildfire hazards, and improve visibility and access for handling livestock. Water quality may be impacted for a short-duration from soil disturbance that will cause soil erosion and sediment transport with potential soluble substances carried in surface runoff water.

Chiseling And Subsoiling (324)

Loosening the soil, without inverting and a minimum of mixing of the surface soil, to shatter restrictive layers below the normal plow depth. This restrictive layer inhibits water movement or root development. This practice will improve water and root penetration plus improve aeration of the soil. This practice works best when properly applied to suitable soils with restrictive layer(s) depths of less than 16 inches. Water quality improvement results from greater infiltration rates and root penetration to utilize a greater rooting and absorption depth for nutrients and soil moisture. If improperly applied, not on the contour, the practice will create greater soil erosion and sedimentation to surface waters.

Clearing And Snagging (326)

Removal of snags, drifts, or other obstructions from a channel. This applies to the clearing of trees, brush and the removal of sediment bars, drifts, logs, snags, boulders, piling, piers, head walls, debris, and other obstructions from the flow area of a natural or excavated channel. The flow capacity will be increased through improved flow characteristics by preventing bank erosion resulting from eddies; to reduce sediment bar formation; to reducing chances for ice jams. Special consideration is given to maintaining habitat for fish and other wildlife. Prior to design and installation contact local, state, and federal regulatory agencies for appropriate permit(s) to work in the stream or floodplain.

Commercial Fishpond (397)

A water impoundment constructed and managed for commercial aquaculture production. It applies to impoundments modified to enhance the production of fish, wildlife, or plants for resale, including fee harvesting on the site.

Conservation Cover (327)

This is the establishment and maintenance of perennial vegetative cover to protect soil and water resources retired from agricultural production. The practice is designed to reduce soil erosion and sedimentation while improving water quality and wildlife habitats. This practice does not meet the same criteria for forage production or critical area plantings. Several seeding mixtures are created to enhance water quality.

Conservation Crop Rotation (328)

This is the growing of crops in a recurring sequence on the same field. The rotation supports the Conservation Management System or Integrated Crop Management system to reduce sheet and rill erosion; reduce irrigation induced erosion; maintain or improve soil organic matter; reduce wind erosion; manage deficient or excessive crop nutrients; improve water efficiency; manage crop pests (weeds, insects, nematodes, and diseases); provide food for domestic livestock; and food and cover for wildlife. Cropping rotations can also aid in improving soil quality. This does not apply to specialty crops or pastureland.

Contour Buffer Strips (332)

This is a narrow strips of perennial vegetative cover established on the contour across the slope alternated with wider cropped strips down slope. The beneficial effects of these strips include reduced sheet and rill erosion; reduced transport of sediment and other water-borne contaminants down slope, on-site and off-site in addition to enhancing wildlife habitat on sloping cropland. This is adapted best to nearly uniform topography to maintain parallel strips across the slope. These strips are not considered cropland or a part of the crop rotation.

Contour Farming (330)

Farming sloping lands in such a way that land preparation, planting, cultivation and harvesting is done on the contour. (This includes following established grades of terraces or diversions.) The practice reduces sheet and rill erosion and controls water runoff. It is used where other cultural and management practices do not control soil and water losses. It often is used in combination with other structural and non-structural conservation practices to enhance benefits.

Cover And Green Manure Crop (340)

A crop of close-growing grasses, legumes, or small grain grown primarily for seasonal protection and soil improvement. It is usually grown for one year or less, except where there is permanent cover as in orchards. This is used to control erosion where major crops do not yield adequate crop residues; to add organic matter to the soil; to improve rainfall infiltration, soil aeration, and tilth; also to retrieve soil nutrients leached out of the root zones of shallow-rooted crops in the fall through spring seasons.

Critical Area Planting (342)

Planting vegetation such as trees, shrubs, vines, grasses or legumes on highly erodible or critically eroding areas (does not include tree planting mainly for wood products.) This planting will stabilize soil, reduce damaging sediment and water runoff to downstream areas while improving wildlife habitat and visual effects. This is applicable to dams, dikes, borrow areas, ditch banks, waterways, diversions, grassed terraces, mine spoil, levees, road cuts and fills, surface mined areas, denuded areas, gullies and urban sites where usual establishment methods prove difficult.

Cross Wind Ridges (589a)

Ridges formed by tillage or planting and aligned across the prevailing wind erosion direction. This is applied as part of a Conservation Management System or Integrated Crop Management system to reduce wind erosion. It is applicable to croplands with stable soils (clayey, silty and silt loam soils) which can sustain stable ridges.

Cross Wind Stripcropping (589b)

Growing crops in strip widths of 660 feet or less established across the prevailing wind erosion direction, and arranged so that strips susceptible to wind erosion are alternated with strips having a protective cover that is resistant to wind erosion. This may be applied as a part of Conservation Management System or Integrated Crop Management system to support reduced wind erosion and/or protecting fragile crop plant tissues from abrasive wind-borne soil particles. Strips should be nearly as perpendicular as possible to the prevailing winds.

Cross Wind Trap Strips (589c)

Herbaceous cover resistant to wind erosion established in one or more strips across the prevailing wind erosion direction. When applied as a part of the Conservation Management System or Integrated Crop Management system it provides reduced wind erosion; increased deposition of wind-borne sediment and attached contaminants on these sediments; crop protection from abrasive action of wind-borne soil particles, and provides wildlife food and cover. These strips are most effective when installed perpendicular to the prevailing winds.

Dam, Diversion (348)

A structure built to divert part or all of the water from a waterway or a stream into a different watercourse, an irrigation canal or ditch, or a water spreading system. These are permanent structures to divert part or all of the water in a controlled manner for beneficial concerns and/or to divert damaging runoff water from designed frequency floods. This is applicable to an irrigation system of a water spreading plan to conserve soil and water. Diverted water will have positive benefits to the aquatic ecosystem.

Dam, Floodwater Retarding (402)

A single-purpose dam designed for temporary storage of floodwater and for its controlled release. The installed structure will reduce downstream damages through controlled release rates based on flow frequencies consistent with environmental hazards and potential pollution. Aquatic and wildlife habitats and water quality are improved through sustained flows.

Dam, Multiple Purpose (349)

A dam constructed across a stream or a natural watercourse that has a designed reservoir storage capacity for two or more purposes. Storage can be designed for floodwater retardation, public drinking water supply, irrigation, livestock watering, fishing, hunting, boating, swimming, improved environmental concerns, habitat for fish and wildlife, municipal or industrial uses and other uses.

Deferred Grazing (352)

Postponing grazing or resting grazing land for a prescribed period to promote natural regeneration through increased forage stand, vigor, and allowing desirable plants to propagate. It also is used to allow for a forage feed reserve for fall or winter grazing, emergency uses; improve hydrologic conditions resulting in reduced soil loss and improved infiltration; better distribution and use of animal nutrients for water quality protection.

Dike, (Earthen) (356)

An embankment constructed of earth or other suitable materials to protect land against overflow or inundation to protect land and property for floodways and/or wildlife enhancements. Dikes have three levels of design: 1) to improve agricultural lands to prevent damage by over land flows; 2) to facilitate water storage and control for wildlife wetlands; and 3) to protect natural areas, historic and scenic features, and archeological sites from damage.

Diversion (362)

A channel with a supporting ridge on the lower side constructed across the slope so as to divert excess surface water from vulnerable areas to sites where it can be used or safely managed. It applies to areas where runoff from an area is damaging the area lying downslope; surface or subsurface flow causes seepage; pollution abatement systems; and/or urban and suburban developing areas and construction sites. It is not meant to be a substitute for a planned terrace system unless used in combination with other upland erosion control measures.

Fencing (382)

Enclosing or dividing an area of land with a suitable permanent structure that acts as a barrier to livestock, big game, or people. (Does not include temporary fences.) It should protect areas from grazing damage such as woodlands, wildlife areas, or stream banks; confining livestock; sub-divide grazing areas within a gazing system; protect seedlings or plantings; regulate access to areas from people or prevent trespassing; and provide safety and security for livestock and humans.

Field Border (386)

A strip of perennial vegetation established at the edge of a field by planting or by converting it from trees to herbaceous vegetation or shrubs. It provides wildlife food, cover, and travel lanes; erosion control; provides edge of fields as machinery travel lanes or "turn-arounds," eliminates end rows; provides for outlets when contour farming; reduces woody plant competition; improves water quality through reduction of nutrient and pesticide application overlaps; and improves aesthetics. It is applicable to stream banks, ditch berms, roads, trails, woodland-cropland and wildlife area-cropland interface zones.

Filter Strip (393)

A strip or area of vegetation for removing sediment, organic matter, and other pollutants from field surface water runoff and feedlot runoff water. [This is not to be confused with field borders or contour buffer strips.] This is applicable to removing potential contaminants from sheet flow runoff water and livestock manure runoff water. The practice increases infiltration, deposition, adsorption, absorption, decomposition, and volatilization of pollutants carried by surface runoff water.

Firebreak (394)

A strip of bare land or vegetation that retards fire to protect soil, water, air, plant, animal, and human resources by preventing the spread of wildfire or to control prescribed burns. Firebreaks may be temporary or permanent. It is applicable to all land uses where protection from wildfire is needed or a prescribed burn is applied. Water quality impairment may occur during the initial re-establishment period or immediately after a wildfire providing sediment or nutrients.

Fish Pond Management (399)

Developing or improving impoundment water to produce fish for domestic use or recreation. This provides favorable aquatic habitat, supplemental food sources and management of unwanted plants and animals in the fishery resource. Management includes proper stocking rates, correct harvesting, aquatic vegetation management, fertility, water control and quality, and habitat improvement.

Forest Stand Improvement (666)

It is the manipulation of specie composition and stocking by cutting or killing selected trees and under story vegetation for the goal of improving and/ or sustaining timber production; harvesting wood or other products; initiate stand regeneration; and improve under story aesthetics, recreational uses, and wildlife habitat. Water quality and hydrology is enhanced with an intensive management plan guiding specie selection and harvesting operations.

Grade Stabilization Structure (410)

A structure used to control the grade and head cutting in natural or artificial channels. This will provide grade and erosion controls while not allowing gully advancement and sustaining the environment. It will improve environmental quality through reduction of potential pollution hazards to streams and other water bodies and human safety issues.

Grassed Waterway (412)

A natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff. [Stone centered waterways are included in this standard.] Waterways convey surface water runoff safely from terraces, diversions, or other water concentrations without causing erosion, flooding and improving water quality. Water quality improvements result from reduction in sediment delivered and the entrapment of sediment, attached pesticides and nutrients from the areas serviced. Waterways have not fully proven to benefit reductions of pesticides in solution resulting from a significant runoff event.

Heavy Use Area Protection (561)

Protecting heavily used areas by establishing vegetative cover, by surfacing with suitable materials, or by installing needed structures on urban, recreational, and structural areas frequented by people, animals, or vehicles. Protection extends to reducing soil erosion and proper management of runoff water to avoid potential surface and ground water contamination.

Hedgerow Planting (422)

Establishing a living fence of shrubs or trees in, across or around a field, to serve as field or property boundaries; living fences; contour guidelines; wildlife food cover and travel; or visual screens. Hedgerows will enhance water quality through increased entrapment of sediment, nutrients, and pesticides while improving wildlife and aesthetics.

Herbaceous Wind Barriers (422a)

Annual or perennial herbaceous vegetation established in rows or narrow strips across the prevailing wind direction. This is applied as a part of a Conservation Management System to support reduced wind erosion; protection of plants from abrasive wind-borne soil particles; manage snow catchment to improve soil moisture; improve wildlife habitat; and integrate beneficial plants, animals, and insects in pest management programs.

Irrigation Field Ditch (388)

A permanent irrigation ditch constructed to convey water from the source of supply to a field or fields in a farm distribution system. This applies to open ditches or channels excluding seasonal surface ditches. A properly designed ditch will reduce soil erosion; improve water quality; and more efficient conveyance without water losses and deep percolation of potential nutrients and pesticides to ground water.

Irrigation Land Leveling (464)

Reshaping the surface of land to be irrigated to planned grades to permit uniform and efficient application of irrigation water without causing soil erosion, loss of water quality, or damage resulting from water-logging while at the same time providing adequate surface drainage. All leveling will be done to facilitate conservation of soil and water resources while preventing water quality degradation from pesticides, nutrients, and sediments.

Irrigation Pit or Regulating Reservoir (552)

A small storage reservoir constructed to regulate or store a supply of water for irrigation until it can be used beneficially to satisfy crop needs. Application of irrigation water as the crop needs dictate brings about greater efficiency and allows for the recapture of potentially contaminated water from pesticides and nutrients.

Irrigation Storage Reservoir (436)

An irrigation water storage structure made by constructing a dam. Surface water is captured and stored during months of low irrigation needs and applied during months of greatest crop needs.

Irrigation System, Trickle [Micro] (441)

A planned irrigation system in which all necessary facilities are installed for efficiently applying water directly to the root zone of plants by means of applicators (orifices, emitters, porous tubing, perforated pipe) operated under low pressure. The applicators can be placed on or below the surface of the ground. Trickle irrigation allows for better soil moisture maintenance in the plant rooting zone without saturating the soil profile that causes the potential leaching of nutrients and/or pesticides. This practice reduces soil erosion; improves water quality; and reduces salt concentrations.

Irrigation System, Sprinkler (442)

A planned irrigation system in which all necessary facilities are installed for efficiently applying water for irrigation by means of perforated pipes or nozzles operated under high or low pressure and/or volumes. This allows for efficient uniform application to maintain adequate soil moisture to optimize plant growth while reducing soil erosion, excessive water loss, and degradation of water quality from nutrients and pesticides. This is suited to most crops except rice and orchards.

Irrigation System, Surface And Subsurface (443)

A planned irrigation system in which all necessary water-controlled structures have been installed for the efficient distribution of irrigation water by surface means, such as furrows, borders, contour levees, or contour ditches, or by subsurface means. This system applies to overall irrigation water distribution and livestock lagoon water handling systems for a given farming enterprise. This system seeks to maximize

efficiency to convey and distribute irrigation water to the point of application without causing soil erosion, water losses, and degradation of water quality.

Irrigation System, Tailwater Recovery (447)

A facility to collect, store, and transport irrigation tailwater for reuse in a farm irrigation distribution system. This practice seeks to maximize water supplies while protecting water quality by recycling the potentially contaminated excess water.

Irrigation Water Conveyance- Ditch (428)

A lining of fixed or flexible impervious material installed in an existing or newly constructed irrigation field ditch, irrigation canal, or lateral. This practice prevents waterlogging of land, to maintain water quality, to prevent erosion, and to reduce water loss. This serves as a integral part of a Conservation Management System to facilitate conservation of soil and water resources on the farm. The practice benefits to water quality are reduced soil erosion and sedimentation, reduced movement of dissolved substances to ground water, improved wetland and other water related wildlife habitats, and the improved visual appearance of the water resources.

Irrigation Water Conveyance- Pipeline (430)

A pipeline and appurtenances installed in an irrigation system to prevent soil erosion, loss of water, degradation of water quality, and/or damage to the land. This helps maximize water conservation.

Irrigation Water Management (449)

Determining and controlling the rate, amount, and timing of irrigation water in a planned and efficient manner for the crops needs at each stage of its' life-cycle. Proper management will minimize soil erosion, loss of nutrients and pesticides, control undesirable water losses from the surface and rooting-zone, and protect water quality from potential contaminants.

Land Reconstruction, Abandoned Mine Land (543)

Restoring land and water areas that are adversely affected by past mining practices and increasing the productivity of the area for a beneficial use. The practice leads to stabilization of mined areas to support vegetation, reduce soil erosion, enhance water quality and/or quantity, provide wildlife habitat, improved aesthetics, public health, safety and welfare. Reclamation standards are based on the intended land uses.

Land Reconstruction, Current Mine Land (544)

Restoring currently mined land to an acceptable form and for a planned use to prevent permanent damage to soil and water resources in and near mined areas. Additionally as part of a Conservation Management System, it will restore the productivity of the soils to permit their pre-mining use or a more intensive use while controlling erosion, preserving the environment, maintaining an economic use of the land and maintaining the aesthetic quality. Water quality improvements include reduced sediment, potential toxic and soluble substances while providing wildlife habitat enhancements.

Land Smoothing (466)

Removing irregularities on the land surface by use of special equipment. This is classified as a rough grading to improve surface drainage for more effective use of precipitation, uniform planting depths, uniform cultivation, improved equipment operation, terrace alignments, and to facilitate contour cultivation.

Lined Waterway or Outlet (468)

A waterway or outlet having an erosion-resistant lining of concrete, broken concrete (without metal rods or wires), stone, or other permanent material. The lined section extends up the side slopes to a designed depth. The earth above the permanent lining may be vegetated or otherwise protected. This type of waterway should not exceed a design capacity of 200 cubic feet per second. This designed waterway provides for safe runoff flows where an unlined waterway would be inadequate due to seepage contributions or unstable soils.

Mulching (484)

Applying plant residues or other suitable materials not produced on the site to the soil surface. This is a part of the Conservation Management System to protect vegetative cover or crops during establishment periods and/or to reduce weed competition, modify the growing environment of new plants, increase infiltration, and reduce soil erosion from disturbed construction sites.

Nutrient Management (Deficit) (590d)

Managing the amount, form, placement, and timing of applications of plant nutrients to supply plant nutrients for optimum forage or crop yields or to supply plant nutrients minimizing entry into surface or ground water. Nutrients are managed from all sources used in the system such as commercial fertilizers, lime or gypsum, livestock manures or municipal wastes, or from crop credits. This is part of the Conservation Management System or Integrated Crop Management system developed by soil, crop, and field. Yields are based on realistically achievable yield goals based on site conditions and managerial capabilities. This standard recognizes that build-up is still a viable option under this situation.

Nutrient Management (Excess) (590e)

Managing the amount, form, placement, and timing of applications of plant nutrients to supply plant nutrients for optimum forage or crop yields or to supply plant nutrients minimizing entry into surface or ground water. Nutrients are managed from all sources used in the system such as commercial fertilizers, lime or gypsum, livestock manures, and municipal wastes, or from crop credits. This is part of the Conservation Management System or Integrated Crop Management system developed by soil, crop, and field. Yields are based on realistically achievable yield goals based on site conditions and managerial capabilities. This standard recognizes that build-up is not a viable option under this situation.

Obstruction Removal (500)

Disposing of rock, stone fences, hedges, or fence rows and filling gullies or abandoned roads to facilitate layout of crop rows, strip cropping, terraces, land smoothing,, roads, and other construction projects on farms ranches, and other areas. Removal of certain obstructions can aid in improving water quality by converting the concentrated surface water flows into sheet form especially where the runoff is potentially contaminated with sediment, nutrients, and pesticides which can pose a potential threat to surface and/or groundwater.

Open Channel (582)

Constructing or improving a channel, either naturally or artificially, in which water flows with a free surface. This practice is used to provide discharge capacity required for flood control prevention, drainage, other authorized water management purposes, or any combination of these purposes. Stability is important in protecting or enhancing water quality, fish and wildlife habitat.

Pasture And Hayland Management (510)

Proper treatment and use of pasture and hayland to perpetuate the desired plant resources, protect the soil from erosion, safe guard the water resource, insure air quality, and provide food and shelter for livestock and wildlife. Management should provide for optimum sustained yield of the plant resource, consistent with production goals. Harvested hay will provide feed of sufficient quality to meet producer goals. Residue will be left to filter runoff and control erosion. Pest management strategies will evaluate the toxicity of the pesticide and position relative to water sources to prevent potential contamination of surface and ground water. Applications of nutrients will evaluate the effects on water sources on adjacent lands. Grazing practices will incorporate delayed grazing to sustain the plant resources and end grazing when the plant has reached its minimum residual height.

Pasture and Hayland Planting (512)

Establishing native or introduced forage species as part of a Conservation Management System for one or more purposes. This practice is used to establish adapted or compatible species, varieties, or cultivars; improve or maintain livestock nutrition and/or health; extend the length of a grazing season; provide emergency forage production; reduce soil erosion by wind and/or water; and improve water quality and wildlife habitat. This practice is applicable to agricultural lands, cropland, pasture, hayland, etc., where forage production is feasible and desirable. Water quality will be improved through better management of

plant diversity and density, reduced sedimentation, improved infiltration, reducing potential contaminants in runoff water from pathogens, nutrients and pesticides. Proper management of plant species will enhance wildlife food, cover, and diversity beneficial to pest management.

Pest Management (Biological) (595b)

Managing agricultural pest infestations (weeds, insects, nematodes, and diseases) to reduce adverse effects on plant growth, crop production, and environmental resources (humans, animals, plants, soil, water and air). This is used as a part of a Conservation Management System to support acceptable environmentally safe pest management programs consistent with selected crop production goals. This practice is contingent on identifying the problem pests needing controls and applicable methods (biological, cultural or mechanical) to be used independently or in combination. All pest management strategies need to evaluate the stated goal for cost-effectiveness and environmental impacts.

Pest Management (Chemical) (595c)

Managing agricultural pest infestations (weeds, insects, nematodes, and diseases) to reduce adverse effects on plant growth, crop production, and environmental resources (humans, animals, plants, soil, water and air). This is used as a part of a Conservation Management System to support acceptable environmentally safe pest management programs consistent with selected crop production goals. This practice is contingent on identifying the problem pests needing controls and applicable methods (cultural or mechanical, or chemicals) to be used independently or in combination. All pest management strategies need to evaluate the stated goal for cost-effectiveness and environmental impacts.

Pest Management (Mechanical) (595m)

Managing agricultural pest infestations (weeds, insects, nematodes, and diseases) to reduce adverse effects on plant growth, crop production, and environmental resources (humans, animals, plants, soil, water and air). This is used as a part of a Conservation Management System to support acceptable environmentally safe pest management programs consistent with selected crop production goals. This practice is contingent on identifying the problem pests needing controls and applicable methods (cultural or mechanical, or rotation) to be used independently or in combination. All pest management strategies need to evaluate the stated goal for cost-effectiveness and environmental impacts. This practice depends upon use of tillage or harvest equipment with appropriate timing.

Pipeline (516)

Pipeline installed for conveying water for livestock or for recreational use and consumption. Pipelines aid in the protection of water bodies by distributing water away from these source, Source Water Protection, especially livestock. Protection of source water affords improved aquatic life and wildlife habitat.

Planned Grazing System (556)

When three or more grazing subdivisions are properly rested and then grazed in a planned sequence for two or more years to optimize forage utilization and production. It is applicable to sites where a plant community is being maintained to reduce soil erosion, safe guard water quality and air quality, and provide for livestock and wildlife food and shelter. Water quality is improved through better distribution of livestock manure, nutrients, and potential pathogenic contaminants. A grazing system is based on stocking rates and rotations for sustainable regrowth.

Pond (378)

A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout. Ponds provide water for domestic use, livestock, fish, wildlife, recreation, fire control, irrigation and other related uses. Water quality benefits from impoundments is primarily with sediment entrapment and minor benefits for nutrient and pesticide catchment.

Pond Sealing or Lining (521)

Installing a fixed lining of impervious material or treating the soil in a pond mechanically or chemically to impede or prevent excessive water loss. Numerous methods (materials) exist to seal a pond, however, costs will generally dictate what is used. Pond sealing is used where water loss is disproportional to its planned use and/or is causing other environmental problems.

Poultry Composting Facility (313a)

A structure for biological stabilization of waste organic material wherein livestock and poultry manure, dead bird and animal carcasses and food processing wastes produced on the farm are converted by micro-organisms into a stable and useful soil amendment, fertilizer substitute, or livestock nutrient. [This standard does not apply to municipal sludge, solid waste, and other non-farm type wastes.] This practice sets forth the minimum requirements to plan, design, operate, and maintain for the normal mortalities of a livestock farming operation. [It is not intended for use during a catastrophic losses.] The practice enables the carcasses to be biologically treated to prevent pollution to the environment, destroy pathogenic organisms, and produce a stable humus-like material that can be used as a soil amendment, fertilizer substitute, or livestock nutrient. It applies where a predictable mortality rate is determined for the operation; composting to properly manage the carcasses in compliance with local and state laws and regulations; and is part of a Conservation Management System which includes the developed livestock manure management plan. Water quality will be improved through proper utilization of the nutrients.

Precision Land Forming (462)

Reshaping the surface of land to planned grades for drainage and erosion control as well as other purposes such as moisture conservation, leaching, and improving water quality. [This does not include land smoothing, recreation land grading, shaping, and irrigation land leveling.] This practice provides surface drainage; allows more effective use of rainfall; facilitates installation of more workable drainage systems; reduces the incidence of mosquito infestations; controls erosion, improves water quality, and prevents damage to land by water logging. Sites will have uniform soil textures and depths to provide an adequate rooting zone to permit the planned use of the land and crops. This is part of a Conservation Management System to facilitate conservation use of soil and water resources. Water quality is improved through more efficient use of water avoiding the potential for leaching of nutrients and pesticides below the rooting zone and surface water runoff contaminants.

Prescribed Burning (338)

Applying fire to predetermined areas under conditions where the intensity and spread of the fire will be controlled. This will control undesirable vegetation, stimulate seed production, reduce excessive accumulation of plant residues, prepare sites for planting or seeding, control plant diseases, reduce hazards of a wildfire, encourage desired changes in plant diversity, improve habitat for selected wildlife species, improve forage quality for livestock, facilitate even distribution of grazing and browsing animals and increase production. Prescribed burns reduces the need for synthetic pesticides.

Pumping Plant For Water Control (533)

A pumping facility installed to transfer water for a conservation need, including removing excess surface or groundwater; filling ponds, ditches or wetlands; or pumping from wells, ponds, streams, and other sources. This assures a dependable water source or a disposal facility for water management of wetlands or provides a water supply for such uses as irrigation, livestock, recreational, or wildlife.

Recreation Area Improvement (562)

Establishing grasses, legumes, vines, shrubs, trees, or other plants or selectively reducing stand densities and trimming woody plants to improve an area for recreation. Managing the recreational area as such reduces soil erosion, provides wildlife cover and food, cover for intensive use areas, screenings, barriers, windbreaks and beautification. Water quality and quantity are benefits through increased infiltration, reducing the movement of sediment, fertilizer, pesticides, organic wastes, pathogens from pets, and other associated wastes from recreational activities.

Recreation Land Grading And Shaping (566)

Altering the surface of the land to meet the requirements of recreational facilities. This applies to areas where surface irregularities, slopes, kinds of soils obstructions and wetness interfere with the planned uses, and maintaining and improving habitat for fish and/or wildlife.

Recreation Trail And Walkway (568)

A pathway prepared especially for pedestrian, equestrian, and cycle travel. This provides users of recreational areas with travel routes for activities such as walking, running, bicycling, sightseeing, horseback riding, etc.. The practice should prevent erosion, preserve and protect soil, plant, animal and visual resources. Water quality issues such as nutrients and pathogens are taken into account.

Residue Management, No Till and Strip Till (329a)

Managing the amount, orientation and distribution of crop and other plant residues on the soil surface year-round, while growing crops in narrow slots or tilled strips in previously untilled soil and residue. This practice is a part of a Conservation Management System which benefits reductions in sheet and rill erosion, wind erosion, conserves soil moisture, manages snow to increase plant available moisture, reduces plant damages from freezing and/or desiccation, and provides food or escape for wildlife.

Residue Management, Mulch Till (329b)

Managing the amount, orientation and distribution of crop and other plant residues on the soil surface year-round, while growing crops where the entire field surface is tilled prior to planting. This practice is a part of a Conservation Management System which benefits reductions in sheet and rill erosion, wind erosion, conserve soil moisture, manages snow to increase plant available moisture, and provides food or escape for wildlife. This applies to chisel plowing or discing both on summer fallowed lands and annual or perennial planted crops.

Residue Management, Ridge Till (329c)

Managing the amount, orientation and distribution of crop and other plant residues on the soil surface year-round while growing crops on preformed ridges alternated with furrows protected by crop residue. This practice is a part of a Conservation Management System which benefits reductions in sheet and rill erosion, wind erosion, conserves soil moisture, manages snow to increase plant available moisture, modification of wet soil conditions, and provides food or escape for wildlife. This practice adapts well to banding of pesticides and nutrients thus reducing significant quantities subject to potential surface or ground water contamination. Weed pressures are controlled with a modified ridge builder/cultivator.

Residue Management (Seasonal) (344)

Managing the amount, orientation, and distribution of crop and other plant residues on the soil surface during part of the year from harvest until tillage occurs for the next years growing season. This practice is a part of a Conservation Management System which benefits reductions in sheet and rill erosion, wind erosion, conserves soil moisture, manages snow to increase plant available moisture, and provides food or escape for wildlife. This practice when managed properly will not contribute to water quality concerns.

Riparian Forest Buffer (391)

An area of trees and/or shrubs located adjacent to and up-gradient from water bodies. This practice can reduce excess sediment, organic materials, nutrients, pesticides, and other potential pollutants in surface runoff or into shallow ground water flow. It provides shade to lower the ambient water temperature to improve fish and other aquatic organisms, provides a source of detritus and large woody debris for fish and other aquatic organisms, creates habitat and corridors for wildlife, mitigates flood velocities, and flatten peak flows. This practice applies to stable permanent and intermittent streams, lakes, ponds, wetlands and areas with ground water recharge. Water quality will be enhanced from reduced levels of nutrients, pesticides, sediments (dissolved oxygen and water temperatures).

Row Arrangement (557)

Establishing a system of crop rows on planned grades and lengths primarily for erosion control and water management. This applies to areas where adequate drainage, soil erosion, or inadequate use of available rainfall or irrigation water exists. This is used as part of a Conservation Management System. Proper management will inhibit sediment, nutrient and pesticide movement.

Runoff Management System (570)

A system for controlling excess runoff caused by construction operations at development sites, changes in land use, or other land disturbances. This applies to proper planning, design, installation, operation, and

management of runoff to include adequate outlets and component practices. The plan includes a designed runoff rates and sediment controls from development sites during and after construction to minimize flooding, erosion and sedimentation thus having a positive impact on water quality.

Sediment Basin (350)

A basin constructed to collect and store debris or sediment where the primary purpose is to trap and store water-borne sediment and debris. This prevents undesirable deposition on low-lying areas and developed sites, reduces or abates pollution by providing storage space for sand, gravel, silt, stone, agricultural waste and other detritus so as to preserve capacities of reservoirs, ditches, canals, diversions, terraces, waterways, streams, wetlands, etc.. Aquatic ecosystems are enhanced greatly when properly operated and maintained. (Includes regularly scheduled cleanouts.)

Spoil Spreading (572)

Disposing of excavated materials from a grassed waterway, drainage ditch or an irrigation canal by spreading the surplus over adjacent land. Disposal of soil will be placed in adjacent surface depressions by shaping or spreading the spoil over the surface along the construction zone. Spreading spoil reduces sedimentation and allows revegetation of adjacent banks to aid in infiltration and filtering of surface runoff water contaminants.

Spring Development (574)

Improving springs and seeps by excavating, cleaning, capping, or providing collection and storage facilities to improve water distribution or to increase the quantity of water for domestic use, livestock, and wildlife. If suitable quantity and quality water exists, irrigation might be an applicable use along with a storage structure. Development of springs affords livestock producers another water source that allows these producers to remove and fence out surface water bodies. This move will enhance water quality by removing livestock manures and potential pathogens from entering the water source.

Streambank and Shoreline Protection (580)

Using vegetation or structures to stabilize and protect banks of streams, lakes, estuaries, or excavated channels against scour and erosion. These stabilization methods prevent loss or damage to roads, utilities, buildings, or other facilities, maintain channel capacities, control channel meanders that could adversely affect downstream or upstream land uses, reduce sediment loads to further damage downstream reaches, improve stream recreation, improve habitat for fish and wildlife, and provide safety to adjacent land users. Water quality improvements result mostly from reduced sedimentation. Prior to design or installation contact the local, state, or federal agencies that regulate permit activities in public waters.

Stream Channel Stabilization (584)

Stabilizing the channel of a stream with suitable structures to control stream channels undergoing aggradation or degradation that cannot be managed using clearing or snagging alone, establishment of vegetative protection or by installing upstream water control structures. Installation reduces sediment loads. Prior to design or installation contact the local, state, or federal agencies that regulate activities in public waters.

Strip Cropping (Contour) (585)

Growing crops in a systematic arrangement of strips or bands on the contour to reduce water erosion. The crops is arranged so that a strip of grass or close-grown crop is alternated with a strip of clean-tilled crop or fallow or a strip of grass is alternated with a close-grown crop. This practice reduces soil erosion and improves water quality and quantity. Water quality improvement is provided through improved infiltration thus reducing potential runoff water contamination from such sources as sediment, nutrients, and pesticides.

Strip Cropping (Field) (586)

Growing crops in a systematic arrangement of strips or bands arranged nearly perpendicular to the prevailing winds to reduce wind erosion. The crops are arranged so that a strip of grass or close-grown crop is alternated with a strip of clean-tilled crop or fallow or a strip of grass is alternated with a close-grown crop. This practice reduces soil erosion and improves water quality and quantity. This practice

increases snow catchment and reduces damage to crops from airborne abrasive soil particles. This practice will provide trap area for airborne sediments with attached nutrients and pesticides from entering surface water bodies.

Structure For Water Control (587)

A structure in an irrigation, drainage, or other water management systems that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation. This practice controls the stage, discharge, distribution, delivery, or direction of flow into open channels or water use areas. It is a practice used whenever a permanent structure is integrated into a Conservation Management System for irrigation, drainage, or other water-control systems to serve one or more of the following functions: 1) conduct water from one elevation to another within, to, or from a ditch, channel, or canal; 2) control elevation of water in drainage or irrigation ditches; 3) diversion or measurement of irrigation water; 4) keep trash, debris, or weeds seeds from entering pipelines; 5) control direction of channel flows resulting from back flow or high water from flooding; 6) control the level of water table or to remove surface or subsurface water from adjoining land, to flood land for frost protection or to manage water levels for wildlife or recreation; 7) provide water control for recreation or similar purposes; 8) to convey water over, under, or along a ditch, canal, road, railroad, or other barriers; 9) modify water flow to provide habitat for fish, wildlife, or other aquatic animals. This is not to be used in lieu of grade stabilization structures when for a head-cut control is the main function. Water quality may be improved provided the detention time for the collected surface water runoff is given ample residence time.

Subsurface Drain (606)

A conduit, such as concrete, clay, or corrugated plastic tubing, tile, or pipe is installed beneath the ground surface to collect and/or convey drainage water. This applies to areas having a high water table and benefits are received by lowering the water table; used in conjunction with other conservation practices to provide foundation stability; and has free flow by gravity or to a pumping system to make the practice cost-efficient. The practice provides an improved soil environment for improved vegetative growth; reduces soil erosion due to improved infiltration; intercepts seepage (ground water flows); regulates sub-irrigated areas; regulates waste disposal areas; removes water from heavy use or valuable assets such a buildings, play areas, roads, etc.; regulates water to control potential health hazards such as liver fluke, flies, or mosquitoes; and potentially improves water quality. Water quality may effect down stream water temperatures; visual quality; deliver dissolved substances (salts, nitrates, etc.) down stream, and sediment depending on whether the system is a closed or partially closed system. This system does not remove water soluble (inorganic or organic pesticides) when discharged into surface waters. This practice will be used according to NRCS wetlands policy.

Surface Drainage Field Ditch (607)

A graded ditch for collecting excess water in a field. It applies to shallow ditches installed to collect surface ponded water from a field with depressions; collect or intercept excess surface water such as sheet flow from natural or graded land surfaces or channel flows from furrows and carry it to an outlet; and collect and intercept excess subsurface water and carry it to an outlet. Generally this applies to flat and nearly flat lands with slowly permeable soils. This does not apply to “surface drainage, mains and laterals” or grassed waterways. This practice will be used according to NRCS wetlands policy.

Surface Drainage Main or Lateral (608)

An open drainage ditch constructed to a designed size and grade. This applies to ditches for disposal of surface and subsurface drainage water previously collected by field ditches and/or subsurface areas. It provides minimum drainage requirements for multi-purpose channels that provide outlets for agricultural lands. [This standard does not apply to surface field ditches or open channel standards.] The practices provides for safe removal; of excess surface and/or subsurface water, intercepts ground water flow; controls ground water levels; provides for leaching of saline or alkali soils or any combination. This practice will be used according to NRCS wetlands policy.

Surface Roughening (609)

Roughening the soil surface by ridging or clod forming tillage techniques to reduce wind erosion on cultivated lands, especially during periods of high probability for erosive winds. Areas with little to no

residue protection and soils capable of forming clods when tilled are most applicable. This practice should be used only in emergency situations. Water quality is improved when applied properly through reductions in air-borne sediments which may carry nutrients and pesticides from entering surface water bodies.

Terrace (Gradient) (600g)

An earth embankment, a channel, or a combination ridge and channel constructed across the slope. [This does not apply to diversions.] Terraces reduce the slope length; reduce soil erosion; reduce sediment loading in surface runoff water; improves water quality; intercepts and delivers surface runoff water in a non-erosive velocity to a stable outlet; retain soil runoff for moisture conservation; prevent gully development; reform the land surface; improve farmability; and reduce flooding down slope or adjacent low-lying lands. This is not applicable to lands with less than 1% slope. Terraces maybe broad based, narrow based, or steep-back sloped cross-sections. Level terraces should be used only where the soils have a high infiltration rate so as not to damage crops or cause ground water contamination. Gradient terraces may use either under-ground tile outlets or vegetated surface water outlets such as diversion, grassed waterways, road ditches, etc.. Water quality is improved through reductions in sediment carrying nutrients, and pesticides that are delivered to surface and groundwater. Water soluble nutrients and pesticides may be partially reduced through increased infiltration and absorption.

Terraces (Storage) (600s)

An earth embankment, a channel, or a combination ridge and channel constructed across the slope. [This does not apply to diversions.] Terraces reduce the slope length; reduce soil erosion; reduce sediment loading in surface runoff water; improve water quality; intercept and deliver surface runoff water in a non-erosive velocity to a stable outlet; retain soil runoff for moisture conservation; prevent gully development; reform the land surface; improve farmability; and reduce flooding down slope or adjacent low-lying lands. This is not applicable to lands with less than 1% slope. Terraces may be broad based, narrow based, or steep-back sloped cross-sections. Level terraces should be used only where the soils have a high infiltration rate so as not to damage crops or cause ground water contamination. Water quality is improved through reductions in sediment carrying nutrients and pesticides delivered to surface and ground water. Water soluble nutrients and pesticides may be partially reduced through increased infiltration and absorption.

Tree or Shrub Establishment (612)

Establishes woody plants by planting or seeding. It is used for the purpose of developing forest products; protecting a watershed; providing wildlife habitat; providing erosion control; reducing water pollution through uptake of soluble nutrients and pesticides carried by sediments and/or runoff water; improving energy conservation and beautification and/or controlling snow drifting. Trees and shrubs provide soil stability to ephemeral gullies, riparian buffer zones, sinkhole treatment sites, etc. by being the first line of defense in catching surface water pollutants and anchoring the soil on the banks of various water bodies. Water quality will be enhanced through reduced loadings of sediment, pathogens, nutrients and pesticides to a receiving water body.

Trough or Tank (614)

A trough or tank, with needed devices for water control and waste water disposal, to provide drinking water for livestock. It applies to all tanks or troughs installed to provide livestock watering facilities supplied from a spring, reservoir, well, or other source. The proper placement will bring about the desired distribution of water to disperse livestock from critical or sensitive areas thus provide for more efficient utilization of forages and removal of animals from water bodies. Water quality is improved by reducing sediment, manures, pathogens, and nutrients entering the body of water and preventing herd health hazards.

Underground Outlets (620)

A conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable and stable outlet. [This does not apply to principal spillways or subsurface drains of ponds.] This practice conveys excess water from terraces, diversions, or grassed waterways. Water quality is improved through sediment reduction, however, water soluble nutrients and pesticides will be piped directly to water bodies creating potential pollution problem.

Use Exclusion (472)

Excluding animals, people and or vehicles from an area not intended for grazing; to protect, maintain, or improve the quantity and/or quality of the plant, soil, air, water, aesthetics and animal resources; maintain adequate cover to protect the soil; and maintain or improve water quality. It is used in areas to protect woodlands, wildlife, streams, ponds, and other water bodies; soil hydrologic values from being damaged; and when animal, human health, or safety hazards are present. Water quality will be improved through reductions in sediments, pathogens, nutrients, and other soluble substances (hazardous or non-hazardous).

Waste Management System (312)

A planned system in which all necessary components are installed for managing liquid and solid manure, including runoff from concentrated manure areas, in a manner that does not degrade air, soil or water resources. This practice establishes the minimum accepted planning and operational requirements. [It does not apply to the design and installation of components.] It is used in rural areas in a manner that prevents or minimizes degradation of air, soil, and water resources while protecting public health and safety. Such systems are planned to preclude discharges of pollutants to surface or ground water and to recycle manure nutrients through soil and plants to the fullest extent practicable. This is a part of the Conservation Management system. Water quality will be improved through reductions in loadings of organics, pathogens, and nutrients into surface waters. When properly designed, managed, and maintained, surface and groundwater quality will not be impaired.

Waste Storage Pond (425)

An impoundment made by excavation or earthfill for temporary storage of animal manures or other agricultural waste. [This does not apply to waste treatment lagoons or storage structures.] This applies where 1) an overall waste management system has been planned; 2) waste is generated by agricultural production or processing; 3) storage is necessary to properly manage the waste; and 4) soils and topography are suitable for construction. Constructed ponds will meet or exceed DNR construction requirements to protect surface and ground water resources. This is a part of the Conservation Management system. Constructed ponds will meet or exceed DNR construction requirements to protect surface and ground water resources. This practice has little effect on the quantity of surface or ground water even though some water is used to mix, dilute, and assist in clean out. Water quality will be improved through reductions in loadings of organics, pathogens, and nutrients into surface waters. When properly designed, managed, and maintained, groundwater quality will not be impaired.

Waste Storage Structure (313)

A fabricated structure for temporary storage of animal manures or other organic agricultural wastes. [This does not apply to waste treatment lagoons or storage ponds.] This is used as a component practice for pollution-control and energy-utilization systems to conserve nutrients and energy and to protect the environment. This applies where 1) an overall manure management system has been planned; 2) manure is generated by agricultural production or processing; 3) storage is necessary to properly manage the manure; and 4) soils and topography are suitable for construction. This is a part of the Conservation Management system. Constructed structures will meet or exceed DNR construction requirements to protect surface and ground water resources. This practice has little effect on the quantity of surface or ground water even though some water is used to mix, dilute, and assist in clean out. Water quality will be improved through reductions in loadings of organics, pathogens, and nutrients into surface waters. When properly designed, managed, and maintained surface and groundwater quality will not be impaired.

Waste Treatment Lagoon (359)

An impoundment made by excavation or earthfill for biological treatment of animal manures or other agricultural waste. [This does not apply to waste storage ponds or structures.] This practice biologically treats organic wastes, reduces pollution potentials, and protects the environment. These lagoons are of three general types,: 1) naturally aerobic; 2) anaerobic; and 3) mechanically aerated. This applies where 1) an overall manure management system has been planned; 2) manure is generated by agricultural production or processing; 3) storage is necessary to properly manage the manure; and 4) soils and topography are suitable for construction. This is a part of the Conservation Management system. Constructed lagoons will meet or exceed DNR construction requirements to protect surface and ground water resources. This practice has little effect on the quantity of surface or ground water even though some

water is used to mix, dilute, and assist in clean out. Water quality will be improved through reductions in loadings of organics, pathogens, and nutrients into surface waters. When properly designed, managed, and maintained surface and groundwater quality will not be impaired.

Waste Utilization (633)

Using agricultural manure or other waste on land in an environmentally acceptable manner while maintaining or improving soil and plant resources. Agricultural manures and other wastes provide fertility for crops, forage, or fiber production; to improve or maintain soil structure; to aid preventing soil erosion; and to safeguard water resources. Where soil and vegetation are suitable for the use of manures and other wastes as a fertilizer, also municipal treatment plants and agricultural processing plants may supplement nutrients when properly planned and applied. This a part of the Conservation Management System. It must meet or exceed the minimum requirements of DNR land application regulations. Water quality will be improved through reductions in loadings of organics, pathogens, and nutrients into surface waters. When properly designed, managed, and maintained surface and groundwater quality will not be impaired.

Water and Sediment Control Basin (638)

A short earth embankment or a combination ridge and channel generally constructed across the slope and minor watercourses to form a silt or sediment basin. [This does not apply to diversions, grade stabilization structures, sediment basins, or terraces.] The maximum watershed is 20 acres for design purposes. This practice serves to trap and collect sediment in water; reduce peak rate of flow to downslope locations; reduce flooding; reduce gully erosion; reform the landscape; and improve potential of areas for farming. It applies where terraces are precluded due to significant water erosion and high sediment delivery. This practice is part of Conservation Management System. Water quality is improved significantly from sediment collection.

Well (Irrigated) (642i)

A well constructed or improved to provide water for irrigation. The practice is a part of a Conservation Management System. This applies to wells driven, drilled, and dug to supply water from an underground water source. [It does not apply to pumps, pipelines, troughs, and tanks.] This practice facilitates for proper cropland management by providing an adequate supply of water for conservation irrigation. Irrigation wells are limited to geologic sites where sufficient quantity and quality ground water is available for the intended land use, and the site is suitable for irrigation. All wells will comply with state water laws and regulations administered by DNR-DGLS and MDOH. Proper siting, design, installation, management and maintenance will insure proper well head protection to prevent potential ground water contamination.

Well (Livestock and Wildlife) (642l)

A well constructed or improved to provide water for livestock, wildlife, or recreation. This applies to wells driven, drilled, and dug to supply water from an underground water source. [It does not apply to pumps, pipelines, troughs, and tanks.] This practice facilitates proper use of vegetation on range, pastures, and wildlife areas; to supply water requirements of livestock and wildlife; and to provide for human use at recreation sites. Wells are limited to geologic sites where sufficient quantity and quality ground water is available for the intended land use and the site is suitable for the intended use. All wells will comply with state water laws and regulations administered by DNR-DGLS and MDOH. Proper siting, design, installation, management and maintenance will insure proper well head protection to prevent potential ground water contamination.

Well Decommissioning (351)

The sealing and permanent closure of a well no longer in use or inadequate to meet current water needs. This practice serves to prevent entry of vermin, debris, or other foreign substances into the well or well bore hole; eliminate the physical hazard of an open hole to people, animals, and farm machinery; prevent entry of contaminated surface water into well and migration of contaminants into unsaturated (vadose) zone or saturated zone; prevent entry of commingling of chemically or physically different ground waters between separate water bearing zones. This practice applies to any drilled, dug, driven, bored, or otherwise constructed vertical water well determined to have no further beneficial use. It does NOT apply to wells that were used for illegal waste disposal and are contaminated. All wells closed must follow all state and federal laws and regulations regarding closure.

Wetland Restoration (Interim) (657)

The construction or restoration of a wetland facility to provide the hydrological and biological benefits of a wetland. This practice applies to both structural and non-structural facilities as needed to establish or restore wetlands. Wetlands provide wildlife benefits; reduce flooding; provide off-site water quality benefits; and provide ground water recharge of acceptable water quality. This applies to natural wetlands that were drained or sites that are capable of storing water for the development of a wetland community

Wildlife Upland Habitat Management (645)

Creating, maintaining, or enhancing areas, including wetlands, for food and cover for upland wildlife. This practice will create, maintain, and enhance suitable habitat by sustaining desired upland wildlife game and non-game species. Specific habitat requirements are found elsewhere. Water quality may be impacted from sediment during the initial development stages but gradually declining for a net gain in improved control of erosion and sediment.

Wildlife Water Facility (648)

Constructing, improving, or modifying watering places for wildlife so as to provide quality and quantity of drinking water. This practice is used to increase specie range of adaptation and improve the habitat for multiple species. Sites are located close to wildlife escape cover. Areas are fenced to protect from cattle watering sites. Structures can include dugout, embankment ponds, springs, seeps, or small tributaries.

Wildlife Wetland Habitat Management (644)

Retaining, creating, or managing wetland habitat for wildlife in order to retain, create, or improve wetland habitat for waterfowl, furbearers, and other wetland wildlife. Wetlands can also be designed for water quality benefits for removal of sediment, nutrients, and pesticides; commercial and industrial waste plus domestic septage treatment. Wetlands are generally impounded and maintained by diking, ditching, flooding, or pumping.

Windbreak/Shelterbelt Establishment (380)

Linear plantings of single or multiple rows of trees or shrubs established for environmental purposes. These purposes include but are not limited to one or more purposes such as 1) reduce soil losses from wind erosion; 2) protect growing plants; 3)improve soil moisture and water conservation; 4) improved irrigation efficiency; 5) manage snow drifting; 6) provide shelter for livestock and wildlife; 7) provide wildlife habitat for game and non-game species; 8) provide living screens; 9) improve aesthetics; 10) ameliorate excessive noise; and 11) improve energy conservation. Water quality is improved through reduced soil particle deposition into surface water bodies along with other potential air-borne contaminants such as nutrients, organic matter, and pesticide. Protected areas show an increase in infiltration and soil moisture due to decreased evaporative demand. Feedlot runoff from snow melt has the potential for establishments catching detached soluble nitrates, phosphorous, pathogens and other organic substances.

Woodland Pruning (660)

Removing all or parts of selected branches from trees to improve the quality of the wood product(s) and appearance of the trees. It is used where the quality of the product is enhanced or it corrects deformities or broken branches, corrects for safety or health, and Christmas or other ornamentals. This practice will not have a significant water quality benefits unless pests are the cause of this activity.

Woodland Site Preparation (490)

Treating areas to encourage natural seeding of desirable trees or to permit reforestation by planting or direct seeding. This is used to prepare a site for conducive establishment of trees while conserving soil and water; improving watershed protection; enhancing wildlife habitat; and production of forest products. It is adaptable to stocking under stocked areas, areas with undesirable species or other vegetation or cropland that are suitable for growing trees. Water quality may have a short period of slight degradation resulting from sediment, nutrients, and pesticides followed by significant improvements depending upon the sites previous history.

CONSERVATION PRACTICES COMBINED
WITH REVISED PRACTICES

Animal Trails and Walkways (575)
Grass and Legumes (Rotation) (411)
Proper Grazing Use (528)
Proper Woodland Grazing (530)
Vertical Drain (630)
Windbreak Renovation (650)
Woodland Improved Harvest (Final) (654f)

REFERENCES

Standards and Specifications, Section IV, Electronic Field Office Technical Guide (eFOTG), USDA-Natural Resources Conservation Service (NRCS), Missouri.

Access eFOTG at:
http://www.nrcs.usda.gov/technical/efotg Click on Missouri on the U.S. Map.

SILVICULTURE

The following information is condensed from the original document, "A Final Report on Missouri Silvicultural and Watershed Protection Practices," produced by the Silvicultural and Watershed Protection Practices Committee, 1987, convened and chaired by the Missouri Department of Conservation. The changes include updating the forest inventory data and adding information about preharvest planning and silvicultural practices used in forested wetlands. Additional data is included about sedimentation and pesticide use. The attached matrix, Table 8, presents a quick reference describing the various silvicultural practices and the agency through which technical, mechanical, and financial assistance is available. Table 8 is presented at the request of DNR and is not discussed in this summary or in the final report.

Forest Cover

Forestland acreage in Missouri is estimated at 15 million acres or 34 percent of the total of 44.3 million acres of land. This is a gain of about ~~8~~ 9 percent from the 1972 Forest Inventory (Spencer). About 627,000 acres are reserved as wilderness acres and parks. About 14.6 million acres is defined as commercial forestland, or timberland, which has the capacity to grow commercial volumes of wood products (Hahn 1989). Approximately 83 percent or 12.2 million acres of the commercial forestlands are privately owned by farmers and other individual owners. Over 145,000 acres of timberlands is owned by the forest products industry. About 1.321 million acres are under the management of the U.S. Forest Service, with about 246,000 acres in other federal lands including Ft. Leonard Wood. The remaining 615,000 acres compose forested state Conservation Areas. Most private commercial forest land is owned by farmers and other individuals. These ownerships are generally small and managed for a variety of objectives, including periodic income from the sale of timber, recreational uses, aesthetics, woodland pasture and other considerations. Results of the 2000 inventory of Missouri show a slight increase in the area of forestland. While forestland area continues to increase, the rate of conversion from other land uses to forestland has slowed. It appears that in the 11 years between inventories (1989 to 2000), the area of forestland increased by approximately 8%. (Missouri Forest Resources in 2000): http://www.ncrs.fs.fed.us/pubs/rn/rn_nc375.pdf.

The Forest Products Industry

The Missouri forest products industry makes a significant contribution to the state's economy. The annual harvest of Missouri timber is estimated at over 709 million board feet of saw timber, stave bolts, veneer logs and posts on the International 1/4-inch basis (Piva and Jones, 1994). More than 33,000 persons are employed by the forest products industry. Value of the wholesale product is estimated at $2.7 billion annually (Devino, 1993 and MDC, 1995). The value paid to Missouri landowners and agencies for forest products is estimated at over $109 million annually (Jones, 1997).

Silvicultural Practices Used or Recommended in Missouri

By definition, silvicultural practices are directed toward the creation and maintenance of a forest that will best fulfill the objectives of the owner (Smith, 1962). Cutting trees in a forest as part of a land use change, as in the conversion of forest to pasture, cropland, non-forested wetland, urban expansion or another non-forest use, is not a silvicultural practice.

More detailed descriptions of silvicultural practices are provided in the technical report. A listing of the harvesting practices used in the evenaged (harvesting most trees at one time so that the next generation of trees are mostly the same age) forest management system include: clearcutting, shelterwood, seedtree, intermediate harvest and precommercial thinning. Harvesting practices used in the unevenaged system include the selection method and modifications of the selection method. Both the evenaged and unevenaged system accomplish growing and naturally regenerating the forest in perpetuity. Other silvicultural practices include preparation of sites for a new forest either through planting of seedlings or use of direct seeding to artificially regenerate a forest or to accomplish reforestation on lands that are currently in nonforest use.

To some extent, silvicultural practices do affect water quality. However, the effects are of relatively short duration, three to seven years, are often difficult to detect and usually cause no permanent degradation of beneficial water uses. Use of forested buffer strips, which separate the silvicultural activity from lakes and streams, are an important method to reduce the impacts of sedimentation. Additionally, buffer strips help to moderate water temperature, decrease sediment and nutrient transport, and trap pesticides before they enter the water. Timber harvests, the most common silvicultural activity, occur infrequently on small areas and amount to about two percent of Missouri's commercial forest land acreage annually. They do not require extensive road construction for access, and rapid vegetative growth response stabilizes exposed soil quickly.

Site preparation for establishment of natural and artificial forest reproduction is done using bulldozers, brush hogs, hand tools, chemicals, or prescribed fire. Bulldozing is the most disruptive type of site preparation, but is limited to small areas because of expense. Brush hogging and the use of hand tools leaves vegetation that protects the soil. The use of chemicals is limited to small areas, where the chemical is less likely to move off the treated site. Prescribed fire is performed under close supervision when carried out on public lands.

Timber stand improvement (TSI) refers to a family of practices used to free selected trees for further growth. TSI is done mechanically or with chemicals to remove undesirable trees. TSI is done on a stand by stand basis, usually a small area up to approximately 25 acres, with little soil disturbance and performed so chemicals remain on the site.

Silvicultural Activity Effects on Water Quality
The following is a brief discussion about water quality indicators and the impacts of silvicultural operations.

Temperature
In the southeastern United States, ambient water temperature maxima in forested watersheds are assumed to be about 85˚F. In small streams, water temperature increases of 6˚F to 13˚F have been documented following regeneration harvests lacking buffer strips. When buffer strips were used, water temperature increases were reduced to 1˚F to 8˚F above ambient. Water temperature ranges returned to normal levels within three to five years as regrowth of vegetation began shading the soil (Wigington, 1985). Benthic organisms react directly and indirectly to temperature increases. Some benthic populations decrease while others increase as stream

temperature rises. Stoneflies (Plecoptera) are highly sensitive to temperature increases. However, in general, most species of benthic organisms are not directly effected, as long as temperatures did not increase over 86˚F during the day (Walsh 1992).

Missouri's water quality standards set maximum temperatures of 90˚F for most waters, 84˚F for certain Ozark rivers designated as cool water fisheries and 68˚F for areas below large springs designated as cold water fisheries. The potential for exceedence of temperature standards would appear to exist. Very extensive harvests might cause water quality exceedances in some of the smaller classified streams, but typically sized harvests in Missouri should not cause exceedence of temperature standards in classified waters.

Dissolved Oxygen

Silvicultural activities should not cause dissolved oxygen levels to drop below water quality standards in lakes or flowing streams. The Missouri standard for dissolved oxygen states effluent shall not cause dissolved oxygen to be lower than 5 mg/liter in classified streams and 6 mg/liter in cold water sport fisheries. Dissolved oxygen levels are related to temperature fluctuations and abundance of nutrients. Dissolved oxygen ranges from approximately 11.3 ppm at 50˚F to 7.6 ppm at 86˚F for stream water emerging from harvested areas (seasonal temperature range measured during the study) (Wiggington, 1985). The fluctuation of dissolved oxygen levels is related to the increase in decomposition rates of plant nutrients as temperature increases. Use of buffer strips minimizes temperature fluctuations. However, apart from short-lived effects in small streams in areas that naturally experience high summer isolation, there is no evidence of a major effect of logging on salmonids from low dissolved oxygen concentrations (Meehan, 1991).

Nutrient Losses

Available data do not indicate any large detrimental increase in dissolved nutrient concentrations in stream flow as a result of silvicultural activities. Nitrate concentrations of 0.83 mg/l are documented in the stream flow of a Missouri watershed after harvesting. Nitrate concentrations in water samples from a buffer strip are approximately 0.4 milligrams per liter. In all study cases, concentrations have remained below the drinking water standard of 10 ppm for nitrates. Studies in Missouri have documented that forested areas release less nitrogen to streams than other land uses. Smart (1980), found water chemistry strongly correlated with land use in the Missouri Ozarks with forested watershed streams averaging 0.005 mg/l nitrate-N and pastured streams 0.716 mg/l. Skadeland (1992), doing similar work in northeastern Missouri, found forested watersheds produced less nitrogen than typical land uses. Sensitive species of benthos can survive in water with a heavy organic load if the water is adequately reoxygenated by riffles. Benthic sampling above and below harvest sites indicate no change in biological richness. Streams free of sewage and fertilizers tend to be capable of processing nitrates and phosphates found in natural levels including nitrates and phosphates occurring in conjunction with forest harvesting (Walsh, 1992).

Turbidity
Missouri water quality standards state there shall be no color that will cause substantial visible contrast with natural appearance of the stream of lake or interfere with its beneficial uses (DNR 1992).

Water flowing through stream calibration equipment prior to forest harvesting indicates turbidity levels of 0.3 to 20 NTU (Nephelometric Turbidity Units), representing essentially pristine levels of water quality. Following a harvest, turbidity levels ranged from 0.6 to 42 NTU on harvests using buffer strips while harvesting without buffer strips resulted in turbidity levels ranging from 0.8 to 69 NTU. (Lawson, 1985, Mussallem, no date, Settergren, 1980). Harvesting does impact benthic life with sediments and cause some low-level turbidity. Increased levels of turbidity, associated with harvesting activities, appear to be associated with peak storm flow events. Young-of-the-year fish subjected to elevated turbidity grew less than those living in clear water causing more fish to migrate from their initial territory (Filipek, 1993). Fish species are variable in sensitivity to sedimentation and increases in turbidity. Trout, smallmouth bass and rock basses, some darters and madtoms are more sensitive than creek chubs and green sunfish. The decrease in the population of northern pike related to turbid water can cause an increase in the population of suckers, a primary forage fish (Filipek, 1993). High levels of turbidity may occur immediately following timber harvesting, but sediments settle quickly. The sediment may smother some benthic species while benefiting others. However, the increased flow in riffles are able to clear the cobbles and gravel of sediment thus providing a healthy benthic habitat (Walsh, 1992). As the forest regrows following a harvest, turbidity levels return to a normal level. Use of buffer strips should be promoted to allow deposition of sediments prior to reaching streams.

Suspended Solids
Following harvesting and site preparation treatments, suspended solid concentrations increase significantly during peak stormflow conditions. As the peak stormflow passes, suspended solid concentrations decline to normal flow levels. Over a three- to five-year period, levels of suspended solids return to a preharvest condition. Peak stormflow occurs for a short time depending upon rainfall rate, duration, and soil moisture content (Settergren, 1980, Miller, 1985, and Patric, 1984). However, as the size of the harvest area increases and the intensity of forest harvesting increases, suspended solids concentrations will also increase (Wehnes, 1995, Patric, 1994). There is a gap in the knowledge of the effects of dissolved and suspended solids on freshwater aquatic communities. Suspended solids have a significant effect on community dynamics when they interfere with light transmission. However, relatively high suspended solid levels, in excess of 20,000 mg per liter, were needed to cause behavioral reactions. Additionally, fish react to increased presence of suspended solids by avoidance, causing instability in some communities (Sorensen, 1977). Short-term exposure to high levels of suspended solids probably does not impede reproductive movements of most warmwater fishes, but chronic exposure could disrupt reproductive behavior (Muncy, 1979). Use of watershed protection practices can reduce levels of suspended solids as vegetation becomes established.

Sediment
Sediment movement is related to the amount of soil disturbance, percentage of the area utilized by the road system, soil type, slope, slope length, amount of rainfall, and other factors. Generally, sediment yields the first year following timber harvest are increased. However, there

is little scientific evidence that sediment generated by silvicultural activities has interfered with beneficial water uses in Missouri. Once the silvicultural treatment is completed, vegetative growth and leaf fall begin to stabilize soil movement on the area. Within a three- to four-year period, sediment yield returns to pretreatment levels (Blackburn, 1985, Lawson, 1985, Patric, 1980, and USEPA, 1993). Analyses of sediment yields on forest land nationwide, for both undisturbed and harvested forest land where BMPs are both used and excluded, show approximately 25 percent of the studies denote yields of about 0.02 tons per acre per year; 75 percent of the studies did not exceed 0.25 tons per acre per year and about 9 percent of the studies, exceeded 1 ton per acre per year (Patric, 1994). Sediment production from uncut eastern hardwood forests ranges from 0.05 to 0.1 tons per acre per year (Patric, 1994 and Scoles, 1994). Sedimentation following clearcut harvesting in the Ouachita Mountains of Arkansas with no BMP is documented at 0.106 tons per acre; a similar study in Oklahoma resulted in 0.126 tons per acre for the first year following harvesting (Scoles, 1994). Selection method harvesting in the Ouachita Mountains resulted in 0.017 tons per acre the first year following harvesting (Scoles, 1994). Clearcut harvesting, using BMP, can result in a 0.019 to 0.025 tons per acre annual soil loss while clearcutting with no BMP resulted in 0.04 to 0.27 tons per acre annual soil loss in a Pennsylvania study (Mussallam, 1980). The sedimentation rate may double during periods of maximum flow for a period of two- to three-years as the regrowth of the forest intercepts and transpires increasingly more water (Patric, 1994). Water quality information from shelterwood and intermediate harvests are not described. Shelterwood and intermediate harvests are expected to respond similarly to selection method harvests as a high percentage of the forest canopy remains following the harvest and a high percentage of the soil on the harvest area is not exposed.

Salmonid fry survival decreases up to 3.4 percent for each one percent increase in fine sediment and 97 percent of northern pike eggs died when covered with one millimeter of sediment (Filipek, 1993). Water movement across riffles clears the cobbles and gravel of some sediment.

Introduction of sediment alone and sediment treated with triphenyl phosphate, a chemical found in PCB substitutes and hydraulic oil, were introduced to two streams and a control. Sediment impact on benthic life was monitored. Although sediments altered drift patterns and percentage of similarity of benthic invertebrate communities, total numbers, number of species, and diversity of benthic invertebrates were not altered. Treatment with sediment and sediment treated with triphenyl phosphates resulted in increased nutrient retention, reduced algal export, and increased production of rooted flora. Leaf decomposition rates and patterns of emergence were not affected by either treatment (Fairchild, et al, 1987). Substantial evidence exists indicating the reproductive behavior of warmwater fishes is variously affected by sediment and suspended solids depending on the time of spawning. Fishes having behavior that protects the eggs from sediments have a reproductive advantage to those more sensitive to sediments (Muncy, 1979).

Nearly 90 percent of the erosion from timber harvesting is traced to the logging road system which is estimated at approximately 17 tons per acre per year (USEPA, 1993). The extent of soil loss is dependent on precipitation amounts, the type of road surface, the grade of the road, length of the road segment between breaks in the grade designed to drain water from the road surface, and the cut and fill used in construction of the road. For most harvesting operations in Missouri, the construction of logging roads is not required for access to the forested tract. In most cases

the main haul road from a timber sale is the country or state government- maintained gravel or hard-surface road system. Haul roads typically utilize existing forest and farm trails. In some cases these trails are improved for vehicle access. Use of forested buffer strips, road construction techniques and other watershed protection practices helps to reduce the impacts to lakes and streams resulting from road building operations. Forest practices do result in sedimentation, which is generally confined to the road system. As the forest grows following a harvest, the sedimentation levels continually decrease over a two- to five-year time span to pre-harvest sedimentation levels.

Fertilizers
Fertilizer use in Missouri for silviculture is virtually non-existent. Except for cases when fertilizer is used in reclamation, tree planting on mining spoils, research projects, nursery operations, and on urban trees, it is not used as a large-scale forestry management practice.

Pesticides
Pesticides used in Missouri silvicultural systems are applied occasionally to small acreage, at low application rates. As long as pesticides are not applied directly to streams or lakes, and a filter strip is used to trap movement of pesticides, there is usually little impact from properly applied pesticides used in silvicultural applications. Herbicides, the most frequently used pesticide, are subject to microbial degradation and inactivation when soil contact occurs.

Soil characteristics, including infiltration capacity, depth to bedrock, organic matter content, clay content, microbiological activity, structure and texture affect the transportation of the herbicide on and off the site (Neary, 1986 and Norris, 1981). Vegetation uptake, degradation, and recycling of herbicide residues can be a key process in herbicide utilization. Herbicides with the highest water solubilities, most resistance to physical, chemical and biological degradation, lowest affinities for absorption onto organic matter, and high application rates have the greatest potential for movement in the environment (Neary, 1986 and Norris, 1981).

All herbicides recommended for use in forest management activities in Missouri are registered and must be applied according to the directions on the label. Few private landowners use herbicides in silvicultural applications without the assistance of professional foresters. Herbicides are used when they are the most efficient method available and will not cause damage to the environment.

Fungicides and insecticides are rarely applied on forest land in Missouri to date. However, the gypsy moth invasion into Missouri is monitored closely. Currently the gypsy moth, a defoliator of hardwoods, has been reported colonizing in counties of Arkansas that neighbor Barry, Taney, and Stone counties in southwestern Missouri, a popular recreation area. The situation is closely monitored by the Missouri Departments of Agriculture and Conservation. Should controls become necessary, low impact insecticides and biological controls are available. An invasion of the gypsy moth can impact water quality through nitrification traced to dropping and frass accumulation in streams and lakes. The principal species of Missouri’s forests are oaks and hickories which are prime candidates for gypsy moth defoliation (Burks, 1993).

Fire Retardants

Fire retardants are a family of chemicals used to aid construction of fire line. Retardants can be applied as liquid or foam. Use of water on wildland fire control is limited because of difficulty obtaining the quantities necessary for controlling the wildfire. The purpose of a fire retardant is to modify the surface tension of water and extend its effectiveness. Most uses of fire retardants occur in the western states. In Missouri, fire retardants are utilized on a limited extent in pickup truck-mounted water tanks in use by MDC and Forest Service fire crews. Water quality problems only exist from the use of fire retardants if the chemicals are applied directly to a lake or stream.

Methods for Reducing Nonpoint Source Pollution

Correctly applied silvicultural practices usually result in minimal, short-term pollution. In relation to land treated by agricultural practices, the amount of soil lost, frequency of soil disturbance, amount of chemicals used, and the acreage treated in silvicultural operations are small scale. However, on site-specific cases some incorrectly applied silvicultural practices can be problematic. Training should be offered to landowners, logging companies, and foresters to ensure watershed protection practices are correctly installed and the effectiveness of these practices monitored.

The influence of mechanized logging equipment on forest management on private lands in Missouri is unknown. Sales of previously unmerchantable wood from the stem and tops of trees will provide an additional source of income for some landowners. Whether the net effect will be to stimulate better management of private woodlands for improved timber resources remains to be seen. The presence of mechanized logging equipment should be seen and used as an educational opportunity to create and maintain a forest that will best fulfill the objectives of the forest landowner.

The following information describes watershed protection practices that can be effective when voluntarily used on silvicultural activities. In controlled studies, these practices tend to reduce the nonpoint source pollution resulting from silvicultural practices.

Pesticide use is regulated through certification of foresters and chemical applicators by the Missouri Department of Agriculture. Chemicals should be used, their containers disposed of and application equipment cleaned according to the chemical label directions. Careful use of chemicals and the use of protective buffer strips along streams should prevent prolonged or serious water quality degradation when used on timber stand improvements, in site preparation, and for weed control on reforestation projects.

Erosion from site preparation can be reduced by practices that minimize soil cover disturbance, including piling brush in wind rows along contour lines, leaving adequate filter strips along streams to trap sediment, and seeding of selected herbaceous vegetation to quickly establish ground cover in addition to the tree crop.

Erosion prevention from road and skid trail construction and use should be carefully planned. Watershed protection practices which have been implemented involve the following:

1. Minimize the total area of disturbance.
2. Restrict roads from steep grades, unsuitable soils, and buffer strips.
3. Provide for road surface protection with the use of gravel, if necessary.
4. Stabilize cut and fill banks with vegetation and brush barriers.
5. Provide for necessary road drainage by using culverts or out sloping with broad base dips.
6. Stabilize the roadbed by constructing water bars, stopping vehicle travel, and seeding the roadbed with grass following the operation.
7. Log when soil moisture content is favorable to avoid rutting.
8. Locate log loading areas on stable, adequately drained soils and so skidding of logs is directed away from streams.

Recommendations

The landowner is ultimately responsible for the cost of using watershed protection practices directly or indirectly through lower stumpage prices (Cubbage, 1987 and McKensey, 1987). It is in the interest of the landowner and industry to use the best available technical information during harvesting activities to maintain long-term productivity of soil forest resources. We can predict a reduction of nonpoint source pollution through the use of watershed protection practices. Voluntary use of these practices should be accompanied by a program that provides educational information to forest landowners, loggers, and foresters. Emphasis should be on the importance of clean water and steps that are effective in ensuring the continued production of clean water from Missouri's forests. Program direction should be provided through a team effort consisting of the following government agencies and representatives of the private business community: Missouri Department of Conservation, Forestry Division, Department of Natural Resources, Water Pollution Control Program, USDA Natural Resources Conservation Service, USDA Forest Service Mark Twain National Forest, University of Missouri School of Natural Resources, Missouri Consulting Foresters Association, and Missouri Forest Products Association.

Table 8 provides quick reference information about silvicultural activities and watershed protection practices. Included are advantages and disadvantages of using the watershed protection practices and the availability of technical, mechanical, and financial assistance through government agencies. This information is provided as requested by the Water Pollution Control Program and is not discussed in this summary or in the final report.

An additional resource for information on methods of reducing nonpoint source pollution from silvicultural operations "Missouri Watershed Protection Practices" is available without charge from the Department of Conservation. Published in 1997, the booklet contains management guidelines for maintaining forested watersheds to protect streams.
http://www.conservation.state.mo.us/documents/forest/private/forest_manag.pdf 2003 Ecopy of the "Forest Management for Missouri Landowners, MDC, 2003

SILVICULTURAL AND WATERSHED PROTECTION PRACTICES

Table 11

PRACTICES	ADVANTAGES	DISADVANTAGES	AGENCY	ASSISTANCE AVAILABLE		
				TECHNICAL	MECHANICAL	
Site Preparation	Preparation of seedling and planting sites.	High degree of soil disturbance.	NRCS MDC DNR	E,G E,G E,G		CS CS
Tree planting on slopes	Reduces soil erosion. Provides sediment trap/nutrient filter for upland areas.	Hand plant or machine plant on contour on steep slopes to avoid gully erosion.	MDC	E, G	Tree planter	SIP
Establish adequate filter strips along streams	Traps sediment and pesticides, reducing the amount entering the stream. Reduces temperature of runoff water. Prevents streambank and channel erosion.	None	MDC, NRCS DNR	E,G E,G E,G	Tree Planter and tree marking	SIP CS CS
Land use conversion to forest	Erosion control and Streambank stabilization	None	MDC NRCS DNR	E,G, E,G E,G	Tree Planter	SIP CS CS

KEY: E = Education, G = Guide sheets and information, CS = Cost Share, MDC = Missouri Department of Conservation, DNR = Missouri Department of Natural Resources, NRCS = USDA Natural Resources Conservation Service, SIP = Stewardship Incentive Program

SILVICULTURAL AND WATERSHED PROTECTION PRACTICES

Table 11 cont'd.

PRACTICES	ADVANTAGES	DISADVANTAGES	AGENCY	ASSISTANCE AVAILABLE		
				TECHNICAL	MECHANICAL	FINANCIAL
Preharvest planning for road system.	Minimize stream crossings. Reduce area of road system.	None	MDC	E,G	None	SIP--Can be covered in the farm management
Locate roads to minimize the total area of disturbance.	Reduces compaction and erosion form the harvest area. More area for growing trees.	None.	MDC	E, G	None	None None
Use gravel to protect road surfaces where necessary.	Reduces soil erosion and rutting from the road surface.	Increases road building costs.	MDC	E, G	None	None
Stabilize cut and fill banks with vegetation and brush barriers.	Reduces sediment movement from cut and fill banks.	Increases road building costs.	MDC	E, G	None	None
Provide road drainage using culverts and water turn out diversions.	Provides water drainage and reduces erosion from the road surface. Allows continued use of roads during wet weather.	Increases road building costs.	MDC	E, G	None	None

KEY: E = Education, G = Guidesheets and information, CS= Cost Share, SIP = Steward Incentives Program, MDC = Missouri Department of Conservation, DNR = Missouri Department of Natural Resources, NRCS = USDA Natural Resources Conservation Service

SILVICULTURAL AND WATERSHED PROTECTION PRACTICES
Table 11 cont'd

PRACTICES	ADVANTAGES	DISADVANTAGES	AGENCY	ASSISTANCE AVAILABLE		
				TECHNICAL	MECHANICAL	FINANCIAL
Seed truck loading areas with grass or plant trees after harvest is completed.	Reduces erosion and provide wildlife habitat.	Limited amount of sunlight available on some sites.	MDC NRCS	E,G E,G	None	None
Provide road drainage by out-sloping the road and using broad base dips.	Provides water drainage and reduces erosion from the road surface. An alternative to use of culverts on seldom used roads.	Requires some rock surfacing and care used to ensure proper out sloping of the road.	MDC NRCS	E,G E,G	None	SIP --Covered in the farm management plan
Close the road after logging is finished. Stop vehicle traffic, seed the road bed, construct water bars as needed.	Reduces erosion from the road bed. Protects the road for future use.	Increases road building costs.	MDC	E,G E,G,CS	None	SIP
Woodland protection from livestock.	Reduces erosion and trampling of tree seedlings.	None	MDC DNR NRCS	E,G E,G E,G	None	SIP CS CS

E = Education, G = Guide sheets, informational material, videotapes, etc., CS = Cost Share,
SIP = Stewardship Incentive Program,
MDC = Missouri Department of Conservation,
DNR = Missouri Department of Natural Resources,
NRCS = U.S. Department of Agriculture, Natural Resources Conservation Service

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CONSTRUCTION

Characterization

Construction activities occur in every county of Missouri. These construction sites range from a two car garage and driveway to highways, roads and bridges to 100+ lot multi-phase subdivision projects. If construction activity disturbs more than one acre of land over the life of the project a Missouri State Operating Permit for stormwater discharges is required. However, there is no reliable way to tell how many construction sites that disturb less than one acre are active in the state. Sites where disturbance is less than one acre are not regulated under the stormwater laws. These small construction sites can range from small subdivisions and single-family homes to agricultural terraces and farm ponds. All sites, regardless of size, have the potential to contribute to nonpoint source pollution if sound best management practices aren't implemented.

A total of 2390 land disturbance permits have been issued between the year 2000 and November 17th, 2003. This "land disturbance" permit is called a National Pollutant Discharge Elimination System (NPDES) permit.
(EPA NPDES website): http://cfpub.epa.gov/npdes/contacts.cfm?program_id=6&type=ALL.

Missouri has regulated stormwater discharges since October 1992 (RSMo 10 CSR 20-6.200 Stormwater Regulations).   Rules of the Department of Natural Resources, Division 20 Clean Water Commission - Chapter 6- Permits, was updated and promulgated in 2003 and can be viewed in its entirety at the following link: http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-6a.pdf
Information on specific NPDES permits can be viewed at the following website:
http://www.dnr.mo.gov/wpscd/wpcp/permits/wpcpermits-stormwater.htm

The land disturbance permits require the use and maintenance of erosion and sediment control measures sufficient to prevent the movement of sediment off-site. Stormwater pollution prevention plans for construction activities are required to be developed before the issuance of a land disturbance permit.

The Missouri Department of Natural Resources approves erosion control programs for municipalities, counties and government agencies interested in designing and implementing their own erosion control plan. This program can cover all of the land disturbance done for or by a city, county or government agency with an approved plan or can be expanded to cover all land disturbance of more than one acre within the jurisdiction of an entity with an approved erosion control plan.

Impacts

Sediment washing from all sizes of construction sites, both above and below the current one acre permitting threshold, can have severe impacts on lakes and streams. Because of the tendency for developers to grade the entire site at one time, then develop the site in phases, large tracts of land can be laid bare for many months, if not years. The amounts of sediment coming off these sites can range from 100 to 200 tons per acre per year.

Because of the difficulty in separating the sediment coming from construction sites from that of natural weathering and other background sources, the intensity of sedimentation in the stream from any individual construction site is very difficult to quantify. However, it can be estimated at the site by using the Universal Soil Loss Equation, which is a standard approach for estimating soil loss.

Sediment suspended in lakes can affect the growth of aquatic plants by reducing the sunlight available to them. High concentrations of sediment (above 20,000 ppm) can cause mortality in adult fish by clogging gills and reducing oxygen intake (Welsh, 1992), while lower concentrations (1,000 ppm) have been associated with chronic effects on aquatic ecosystems such as altered invertebrate drift pattern, increased nutrient production, reduced algal export and increased production of rooted flora (Fairchild et. al., 1987). Sediment deposition in streams and lakes can affect bottom dwelling fish and aquatic insects and disrupt normal reproduction in fish by covering spawning grounds. Large sediment deposits can fill stream channels and flood plains increasing the potential for flooding.

Sediment also carries other pollutants such as hydrocarbons, pesticides, fertilizers and other construction chemicals as it migrates into stream channels and other water bodies.

Best Management Practices (BMPs)
Best management practices for land disturbance are listed following the urban/suburban stormwater runoff section in this appendix. The first and by far the most effective best management practice is site planning. Careful site planning can eliminate many potential erosion and sedimentation problems by preventing them from occurring in the first place. Site planning can take into account the various slopes, soil types, drainage patterns and other variables and work out a site plan that will be compatible with the proposed land use.

Project phasing is another excellent best management practice. The phasing of a project can keep large areas from being graded and laying unstabilized for months if not years. By careful planning, only the phase that is being developed will be disturbed and unstabilized at any given time.

There is a wide range of BMPs available for erosion and sediment control. These practices can be vegetative, structural or a combination of both. Each site is unique, so it is difficult to establish BMPs that will work in every situation. Careful planning and the development of a storm water pollution prevention plan for construction activities can go far in establishing the types and combinations of BMPs that will be effective in controlling erosion and sedimentation from any given construction site.

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URBAN/SUBURBAN STORMWATER RUNOFF

Characterization

Urban stormwater runoff carries a myriad of pollutants directly and indirectly to Missouri's streams and lakes. In the past, attention focused on the impacts of "end-of-pipe" discharges to streams where, prior to regulation, industrial and domestic wastewater were piped directly to streams. When the effects of this philosophy attracted national attention because of the burning of the Cuyahoga River in Ohio, a massive national effort, supported by the Clean Water Act, was undertaken to clean up point source discharges. That effort has been largely successful. As the negative impacts of pipe discharges diminished, the often-overlooked impacts of the nonpoint sources of pollutants, such as urban stormwater runoff, became more apparent. These sources, in which stormwater picks up and transports industrial, commercial, residential and transportation pollutants to water bodies, can be significant and can cause violations of water quality standards.

A study in Menomonee, Wisconsin, concluded that less than 20 percent of urbanization of an area was sufficient to cause significant degradation of surrounding receiving streams. This degradation is from both pollutants and altered habitat conditions. According to a 1992 USEPA document, stormwater runoff from agriculture and from urban areas are the two leading causes of surface water quality impairment nationwide. The nature of this pollutant problem, however, is different from traditional end-of-pipe discharges. Outfalls can be a point of discharge, such as a storm sewer outlet, or diffuse, such as sheet flow. Pollutants carried by stormwater become both a point and nonpoint source. Rainfall knows no facility or political boundaries. Runoff usually commingles and runs to the same discharge point or water body.

It is important to be able to understand the varied and ubiquitous nature of stormwater flows in order to identify ways to solve the pollutant problems that result from stormwater runoff. The concentration of pollutants in any one runoff event will vary from outfall to outfall, and these differences can be based on many factors. Concentrations will vary during the course of a storm, from event to event at the same point of discharge, from site to site within the same area, and from one urban area to a different urban area. Stormwater can follow various paths. It can be absorbed by surface soils; intercepted by vegetation; directly impounded by surface features such as a small depression, a lake or reservoir; infiltrate to groundwater, run directly to a lake or stream, or travel back and forth among these paths. For example, stormwater can infiltrate into groundwater and later exit to surface waters via a seep or spring. Finally, the amount of runoff contributed from a specific drainage area will vary by the soil moisture content prior to the storm, porosity of soil, relief of topography, organic material content of the soil, land cover, and size and duration of the storm event. In other words, stormwater runoff is not a continuous discharge with a predictable level of pollutants and a predictable daily volume as with the more commonly regulated and understood end-of-pipe discharges.

Urban Stormwater Regulations

Urban stormwater is regulated under the National Pollutant Discharge Elimination Permit System (NPDES) in several ways, as described in 40 CFR Part 122. Since Missouri has been

designated by the U.S. EPA to administer this program, this discussion will hereafter refer to state regulations to govern wastewater and stormwater discharges. Missouri environmental regulations require that discharges from large and medium municipal separate storm sewer systems (commonly referred to as an MS4) be permitted by the Department of Natural Resources, 10 CSR 20-6.200 (4). A large MS4 is defined as an incorporated place with a population of 250,000 or more. A medium MS4 is defined as an incorporated place with a population of 100,000 or more but less than 250,000, 10 CSR 20-6.200 (1)(C) 10 & 14. Counties are included in these definitions. However, if cities or counties have populations on combined sewer, local authorities can petition the department to exempt those populations in areas where the stormwater would flow to a combined sewer 10 CSR 20-6.200 (4)(B) 9.

Under these definitions, stormwater runoff is regulated in the Missouri cities of Springfield, Kansas City, and Independence. The City of St. Louis is almost entirely on combined sewers, so it has petitioned out of the current stormwater regulations and does not require a permit. Stormwater issues for these areas will be addressed under new Combined Sewer Overflow regulations. In addition, some portions of Kansas City are also on combined sewer, and the city was able to exempt these populations and petition into the category for medium-sized cities. Therefore, in Missouri, these three localities are classified as medium-sized cities and are required to have a stormwater discharge permit.

If urban runoff from other cities than these three is found to be a significant contributor of pollutants for reasons identified in 10 CSR 20-6.200(1)(C)10, then the department director may also designate these urban areas subject to regulation and require these urban areas to obtain a stormwater discharge permit for control of pollutants.

Please see the attached technical bulletin for additional information on Stormwater.
http://www.dnr.mo.gov/oac/pub223.pdf

Other stormwater regulations are applicable in urban areas, and are separate from and overlap some of the regulatory jurisdiction identified above. First, almost all industrial sources of stormwater runoff are regulated, 10 CSR 20-6.200(2). In Missouri, these sources are divided into three categories:

1. Industries that are required to have a stormwater discharge permit,
2. Transportation industries that are required to have a permit if any transportation-related activities such as fueling are exposed to stormwater, and
3. So-called “light” industries that are required to have a permit only if industrial activities are exposed to stormwater.

Since many of these industries are located in urban areas and their stormwater becomes part of the urban flow discharged by the MS4, the industrial stormwater regulations also offer a handle in managing urban stormwater pollutants.

Second, land disturbance activities greater than one acre as part of a common plan or sale over the life of the project are also required to obtain stormwater discharge permits, 10 CSR 20-

6.200(3). As with industrial sources, this permitting requirement offers a regulatory handle on construction activities that often occur largely in urban areas.

Pollutants and Sources in the Urban Landscape

Table 9 identifies common sources of urban runoff pollutants. As is apparent, the urban environment contributes almost the full spectrum of potential pollutants from a variety of sources. It is useful to remember that exposure to stormwater is the single unifying factor in these sources, pollutants, and potential pathways. The type of surface also plays a role. Roofing materials and galvanized pipes, for example, contribute trace metals to runoff. Other sources, such as pet droppings, motor oil, and road salt may accumulate on impervious surfaces such as roads and parking lots.

Table 12 - Pollutants and Sources in the Urban Landscape

Source	Pollutant of Concern
Erosion	Sediment and attached soil nutrients, organic matter, and other adsorbed pollutants.
Atmospheric Deposition	Hydrocarbons emitted from automobiles, dust, aromatic hydrocarbons, metals, and other chemicals released from industrial and commercial activities.
Construction Materials	Metals from flashing and shingles, gutters and downspouts, galvanized pipes and metal plating, paint and wood preservatives.
Manufactured Products	Heavy metals; halogenated aliphatics; phthalate esthers; PAHs; other volatiles; phenols and oil from automobile use, zinc and cadmium from tire wear, and pesticides and phenols from other uses including industrial.
Landscape Maintenance	Fertilizer and pesticides. Generally as impervious area increases, nutrients build up on surfaces and runoff transport capacities also rise, resulting in high loads. Exceptions include intensively landscaped areas (e.g., golf courses and cemeteries).
Plants and Animals	Plant debris and animal excrement.
Septic Tanks	Coliform bacteria, nitrogen (NO_3).
Non-Stormwater Connections	Inadvertent or deliberate discharges of sanitary sewage and industrial wastewater to storm drainage systems, including illicit connections, leaking sanitary collection systems, spills, industrial and commercial activities, construction activities, infiltration of contaminated groundwater, and improper disposal.
Accidental Spills	Pollutants of concern depend on the nature of the spill.

Source: USEPA. June 1992

Sediments

Sediment loading to streams in the urban environment comes largely from construction sites. Uncontrolled sediment loads from construction sites have been reported to be on the order of 35 to 45 tons per acre per year. Another study on the Anacostia River in Washington, D.C., estimated that sediment loads from construction sites range from 7 to 100 tons per acre per year. Sediment transport to streams carries with it nutrients (in particular, phosphorus) and organic matter that are attached to the soil. Physical modifications in the watershed and to stream channels can increase stream bank erosion, which can also contribute significant loads to receiving waters.

Environmental effects of increased suspended solids or settleable solids in streams include increased turbidity, reduced light penetration, reduced prey capture for sight feeding predators, clogging of gills/filters of fish and aquatic invertebrates, reduced benthic habitat, and reduced spawning and juvenile fish survival.

Nutrients
Nitrogen and phosphorus are the primary nutrients added to lakes and streams from stormwater runoff. Usually, phosphorus is the limiting nutrient in freshwater systems. Urban lakes and impoundments with detention times of about two weeks are at the greatest risk of environmental problems from nutrient enrichment. The addition of nutrients leads to algal growth and surface scums, water discoloration, and taste and odor problems. Furthermore, algal decomposition can lead to depressed dissolved oxygen levels and the release of toxins that may have been taken up or produced by the algae.

Generally, nutrients build-up and runoff increases as impervious surface areas increase. However, golf courses, cemeteries, and intensely landscaped areas may be exceptions to this rule if proper environmental management practices and controls are not used.

A study done on the Dillon Reservoir, which is a 2,970-acre impoundment of the Blue River in Colorado, provided information on phosphorus loading. Phosphorus was found to be the primary contributor to the eutrophication of the reservoir. Human activities in an urban area were found to account for about half of the total phosphorus load.

Another source of phosphorus in the urban environment is construction. Because phosphorus adsorbs to the soil, erosion and sediment deposition from construction activities can produce far higher loadings than any finished land use. These loadings are temporary, and levels will become more representative when the disturbed areas are stabilized.

Oxygen demanding substances
Urban runoff can depress dissolved oxygen (DO) levels after large storms, and biochemical oxygen demanding (BOD) solids can accumulate in bottom sediment causing impacts during periods of dry weather. BOD levels can exceed 20 mg/l during storm events, which can lead to anoxic conditions in shallow, slow-moving or poorly flushed receiving waters. The greatest BOD export typically occurs from older, highly impervious, highly populated urban areas with outdated combined storm sewers. Newer, low-density suburban residential development usually exports only moderate BOD levels.

Pathogens
Pathogens in urban stormwater runoff include bacteria, protozoa, and viruses that can cause disease in humans. In water quality analysis, the presence of bacteria such as fecal coliforms is generally used as an indicator of a potential risk to human health.

Older and more intensively developed urban areas produce the greatest export of bacteria. Animal excrement, combined sewers, sanitary sewer overflows or leaks, and illicit connections are primary sources of the contamination. A 1987 study by the City of New York found that coliform levels increased three to eight times above normal after rainfall events in several water

bodies and the study concluded that these increases were due to urban stormwater runoff and combined sewer overflows. Coastal areas have been forced to close acres of shellfish beds because of bacterial contamination. Since bacteria multiply faster in warm weather, there is also a seasonal effect.

The USEPA's Nationwide Urban Runoff Program (NURP) study, published in 1983, found that urban runoff typically contains fecal coliform densities of 10,000 to 100,000 organisms per 100 milliliters. Although these are obviously high numbers, drawing a conclusion on health effects is a little uncertain because coliforms are only an indicator of risk and because of the temporary nature of the discharge. However, these numbers can cause concern in slow-moving waterways and lakes and streams used by humans for primary and secondary contact recreation.

Toxic Pollutants

Toxic substances are broadly defined as materials capable of producing an adverse response or effect in a biological system. Toxic compounds such as trace metals, hydrocarbons and pesticides including herbicides are routinely detected in urban stormwater. Although presence in the water column is temporary in nature and human health and aquatic life impacts difficult to determine, the problem is that over the long-term, toxic chemicals tend to accumulate in benthic sediments of urban streams and lakes. Re-suspension of bottom sediments can present an additional exposure route to aquatic organisms.

Metals

Heavy metals are known to have toxic effects on aquatic life and the potential to contaminate drinking water supplies. Studies have found that the urban environment contributes copper, lead, and zinc in the highest concentrations, with cadmium a distant fourth. However, when inappropriate connections between sanitary and storm sewers are present, other heavy metals such as arsenic, beryllium, chromium, mercury, nickel, selenium, and thallium can be found. In the NURP study, lead, zinc, and copper were detected in over 70 percent of the samples taken of stormwater runoff. Chromium and arsenic were found in about 50 percent of the samples.

A study was conducted on the Saddle River, in New Jersey, of which 60 percent of the watershed is urbanized. Water samples were analyzed for lead, zinc, copper, nickel, and chromium. Lead and zinc accounted for 89 percent of the total metals observed. Copper, nickel and chromium were usually found in smaller quantities. When the actual rainfall was sampled, it was found that the rainwater contributed between 4 and 10 percent of the metals concentrations. In this study, metal loadings tended to correlate with increased percentages of commercial and industrial land-use.

The City of Bellevue, Washington, the U.S. Geological Survey, and the Municipality of Metropolitan Seattle monitored concentrations of metals in stormwater runoff in urban areas. This study found that heavy metals originated primarily from street dirt and that concentrations were higher near the source areas than in the stream itself. An interesting conclusion of this study shows the complex and interrelated nature of stormwater pollution with many other phenomena. Urbanization has led to rapid stormwater conveyance to streams which produces much larger stream discharges and shorter stream flow periods. This rapid transport actually lowers the pollutant concentrations in the stream as they are diluted and carried away more

rapidly. However, the increased flows also wash away smaller fish and organisms that, when present, are part of a healthy aquatic system. Therefore, reducing flows and maintaining natural flow patterns may also need to be accompanied by increased management practices upstream to prevent and treat contaminants from entering the waterway.

The City of Seattle found that copper concentrations in the Duwamish River exceeded the USEPA's acute freshwater criterion (18 μg/l) and the lead concentrations exceeded the USEPA chronic freshwater criterion (3.2 μg/l). The highest concentrations of metals were found unevenly distributed in the sediments of the river, suggesting that contaminants came from localized sources. In fact, lead concentrations were as high as 18,000 ppm in storm drains. Near a lead smelter, the sediments were found to contain 350,000 ppm lead. Again, sources were varied; illegal dumping, mismanagement of industrial chemicals and wastes, industrial activities, and storm drain sediments all contributed to the problem. Removal of sediments (some of which were treated as hazardous wastes) from storm drain systems and reductions in contaminant inputs from industrial facilities reduced loadings.

As noted earlier, trace metals can also be contributed when stormwater comes in contact with roofing materials, down spouts, galvanized pipes, metal plating, paints, wood preservatives, catalytic converters, brake linings, and tires. Finally, it should be noted that levels of lead in stormwater runoff in urban environments have declined over time with the use of non-leaded gasoline. However, levels of methyl-tetra-butyl-ether (MTBE) or other compounds added for octane enhancement are increasing.

Petroleum hydrocarbons

The rainbow colored sheen often found on urban surface waters comes from petroleum hydrocarbons. Sources include gasoline leakage from automobiles, spills, construction equipment, and service stations. Some hydrocarbons, such as the polynuclear aromatic hydrocarbons, are known to be toxic to aquatic life at low concentrations.

Hydrocarbons have a high affinity for sediment, and they tend to accumulate rapidly in the bottom sediments of lakes and estuaries. Bioaccumulation of hydrocarbons in fish and shellfish can be toxic to these aquatic organisms as well as becoming an exposure route to humans.

Pesticides

Pesticide use in urban areas is an emerging problem that has been overshadowed in the past by concerns about agricultural use. However, the growth of the lawn-care industry, expansion of urban areas, and new chemicals introduced into the market for home and garden use have affected the use of pesticides in urban areas and public perception of their environmental impacts. A 1991 USEPA study found that one-fourth of the conventional pesticides used in the United Sates were used for non-agricultural purposes. Of this amount, 69 million pounds of active ingredients were specifically used in homes and gardens. The large number and types of chemical compounds, the multitude of applicators, a long growing season, and the smaller amount of land area involved versus agricultural acreage make urban pesticide use a unique problem.

Urban drainage areas composed of vegetated areas contribute far less pesticide amounts to surface waters than urban drainage areas composed of impervious surfaces such as parking lots, making surface characteristics of the watershed an important part of the analysis of this problem.

Lawn and garden pesticides such as diazinon and 2,4-D were found in urban waters in a study completed in Minnesota. Some agricultural pesticides have been found to show up in urban watersheds, probably from atmospheric deposition. However, it is not known if atmospheric deposition of pesticides is a significant problem.

Sodium and chloride
Road salting in winter results in discharges of sodium and chloride to surface waters. These discharges can effect the taste of drinking water, and can damage salt-intolerant plant species. Sodium and chloride concentrations in runoff are not typically large enough to cause serious water resource problems because of the continuous flushing of storm events. However, they may become a problem in drinking water supplies and water resources such as lakes and groundwater that are not well flushed.

Temperature
In summer, runoff from urban areas can warm receiving waters. In a 1991 study of the thermal impacts of urban runoff, the study concluded that average stream temperature increased linearly with impervious area percentage. With 12 percent impervious area, some violations of temperature criteria occurred; violations increased in severity and frequency with increased imperviousness.

In addition, many of the treatment practices used to treat stormwater runoff contribute to a rise in temperature in receiving streams. Water held in impoundments becomes heated when held for an extended time in hot weather, causing receiving waters to have violations under both baseflow and storm runoff conditions. These rises in temperature can adversely affect algal species composition and cold-water invertebrates and fish.

Floatables
Storm water also carries with it solid waste left by humans on industrial and commercial facilities, parking lots, roads, and other impervious areas. Plastic and paper products, garden refuse, tires, and metal and glass containers make their way to waterways via stormwater. Such trash is mostly a visual problem, blemishing the esthetic quality of communities. However, some mortality of fish and other aquatic life occurs due to ingestion or entanglement.

Additional Factors
Besides the materials themselves, it is important to remember that other water quality characteristics such as temperature, pH, dissolved oxygen levels, alkalinity, hardness, and conductivity affect the behavior and fate of pollutants in the receiving stream. For example, metals generally become more soluble as pH drops below neutral. When this happens, the metals become more bioavailable to organisms and can cause greater adverse reactions. Depleted dissolved oxygen can also make some metals more soluble. Anaerobic conditions in the bottom of lakes release phosphorus from sediments. Elements creating hardness may mitigate some of the toxicity of many heavy metals.

Data have been collected that describe typical stormwater runoff characteristics. Table 10 below presents concentrations of several of the pollutants and compares those with water quality criteria to protect aquatic life. While concentrations generally range widely, the mean values tend to be low. Also, urban runoff often does not cause prolonged water quality criteria exceedances because of its temporal nature and dilution in the receiving water.

Table 13: Pollutant Concentration Statistics for General Urban and Highway Runoff

CONSTITUENTS	GENERAL URBAN		HIGHWAYS RUNOFF		LIMITS FOR PROTECTION OF AQUATIC LIFE**
	MEAN	RANGE*	MEAN	RANGE*	
Suspended Solids (mg/L)	150[2]	2-2,890	220[3]	14-522	
BOD (mg/L)	9[1]	0.41-159			X
COD (mg/L)	65[1]	<10-1,031	124[3]	34-1,291	X
Lead (µg/L)	140[1]	3-28,000	550[3]	10-3,775	16
Copper (µg/L)	34[1]	4-560	43[7]	13-288	28
Zinc (µg/L)	160[1]	10-5,750	380[3]	40-25,500	340
Cadmium (µg/L)	0.7[8]	0.7-30			11.8
Chromium (µg/L)	7[8]	<10-110			42
Nickel (µg/L)	12[8]	<2-126			500
Arsenic (µg/L)	13[8]	10-130			20
Organic Pesticides (µg/L)	X	0.002-0.35[8]			X
Phthalate Esters (µg/L)	X	0.06-160[8]			DEHP-5.9 all other PAEs- 12,000-2,900,000
Phenols (µg/L)	X	8-115[8]			100
Oil & Grease (mg/L)	7.8[4]	up to 35.7	30[6]		10
Total Hydrocarbons (mg/L)	3.7[5]	1.8-43			X
Polynuclear Aromatic Hydrocarbons (µg/L)	X	<0.01-12	3.7[6]		0.49-BaP 0.49-110,000-Others
Total Nitrogen (mg/L-N)	1.5[1]	0.34-20	2.72[3]	up to 3.4	X
Total Phosphorus (mg/L)	0.33[1]	0.01-4.3	0.59[3]	up to 0.7	
Alkalinity (mg/L)	38.2[4]	5.5-87			
PH	X	6.2-8.74		6.6-8.0[6]	6.5-9.0

X No data reported
* Range of actual values reported in literature from various studies unless otherwise indicated.

** Maximum concentrations for the protection of freshwater aquatic life or human health--fish consumption, Water Quality Standards, 10 CSR 20-7.031. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7b.pdf
*** For lakes with salmonids as predominant fish species.
[1] U.S. Nationwide Urban Runoff Program database.
[2] U.S. EPA database.
[3] Median of U.S. Federal Highways Administration database.
[4] Light Industrial Catchment in British Columbia.
[5] General Urban Catchment in Philadelphia.
[6] Highway runoff in England.
[7] Highway runoff in Washington State.
[8] Data from Metro Seattle.

Source: British Columbia Res. Corp. 1992 and Terrene Institute

Table 11 presents typical loadings for a number of pollutants and land uses. These numbers are expressed in the number of pounds contributed per acre per year. Variation from place to place and from year to year can be substantial. However, the numbers are useful in both quantifying the total loadings and understanding the nature of the problem.

Table 14: Typical Pollutant Loadings from Urban Land Uses in lbs/acre-y

LAND USE	TSS	TP	TKN	NH_3-N	NO_2-N	BOD	COD	Pb	Zn	Cu
Commercial	1,000	1.5	6.7	1.9	3.1	62	420	2.7	2.1	0.4
Parking lot	400	0.7	5.1	2.0	2.9	47	270	0.8	0.8	0.04
High-density residential	420	1.0	4.2	0.8	2.0	27	170	0.8	0.7	0.03
Medium-density residential	190	0.5	2.5	0.5	1.4	13	72	0.2	0.2	0.14
Low-density residential	10	0.04	0.03	0.02	0.1	NA	NA	0.01	0.04	0.01
Freeway	880	0.9	7.9	1.5	4.2	NA	NA	4.5	2.1	0.37
Industrial	860	1.3	3.8	0.2	1.3	NA	NA	2.4	7.3	0.50
Park	3	0.03	1.5	NA	0.3	NA	2	0.005	NA	NA
Construction	60,000	80	NA	NA	NA	NA	NA	NA	NA	NA

NA not available
Source: Pitt, 1991; Horner and Mar, 1982 and Terrene Institute

As noted above, water quality is impaired by land uses that contribute pollutants to groundwater or runoff. The quantity of water released is yet another issue and is influenced by the physical characteristics of the watershed, such as slope, vegetative cover, soil compaction, and impervious cover. All of these characteristics are extremely altered in an urban environment and lead to additional environmental degradation in urban streams. These changes are discussed in greater detail in the following section and at the Center for Watershed Protection website: **http://www.cwp.org**

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Construction/Urban Best Management Practices

NONPOINT SOURCE WATER QUALITY
CONSERVATION PRACTICE EFFECTS RANKING*

Significant Positive Water Quality Benefit or Control	**+2**
Good Water Quality Benefit or Control	**+1**
Negligible Water Quality Benefit or Control	**0**
Negative Water Quality Impact	**-1**
Significant Negative Water Quality Impact	**-2**
Variable (Positive or Negative) Water Quality Impact	**+/-**
Conservation Practice Not Applicable to Water Quality	**NA**

* The numeric ranking is intended to be only a general guideline. Positive and negative impacts will vary from site to site. The conservation practices listed are examples and may change for each specific location. Specific conservation practices may be used for more than one resource concern.

Soil Tilth, Crusting, Water Infiltration, Organic Materials
Soil condition based on suitable combinations of mineral, water, air, organic matter, resulting in proper habitat for microbial activity and chemical reactions to occur.

Soil Compaction
Excess compression of soil particles and aggregates by machine, livestock, and natural consolidation, thereby affecting plant-soil-moisture-air relationships.

Soil Contaminants

Other Excess Animal Manures and Organics
Excess animal waste and other organics restrict the desired soil use.

Excess Fertilizers
Quantity of nutrients restricts desired soil use.

Damage On-site
Need to rework ground due to sediment thickness and distribution; crops destroyed; infertile deposition, especially for coarse textured soils.

Damage Off-site
Same as on-site damage. Off-site practice effects are less than on-site because of increased distance from source of problem.

Suspended Sediment and Turbidity
Suspended sediment is sediment held in surrounding fluid; turbidity is reduced clarity of fluids due to the presence of matter.

Aquatic Habitat Suitability
Water quality and physical nature of the stream provide a suitable home for fish and other aquatic life.

TABLE 15: NONPOINT SOURCE WATER QUALITY IMPACTS FROM STORMWATER MANAGEMENT PRACTICES APPLIED TO URBAN LAND DISTURBANCES (12/28/98)

CONSERVATION PRACTICE / (NRCS CODE)	SHEET & RILL EROSION	RILL & GULLY EROSION	STREAM-BANK EROSION	STREAM CHANNEL EROSION	REDUCED TOXICS & SALT	FLOODING	INCREASED PEAK FLOW	NUTRIENT POLLUTION	PESTICIDE POLLUTION	SEDIMENT DAMAGE	DUST CONTROL	CONSTRUCTION ROAD MAINTENANCE	WATER TABLE CONTROL	ORGANIC POLLUTION
BUFFER ZONE/STRIP (000)	+1	+1	+2	+2	+1	+/-	+/-	+2	+/-	+1	NA	NA	NA	+2
CATCH BASIN CLEANING (000)	NA	NA	NA	NA	NA	NA	NA	+1	+1	NA	NA	+1	NA	+2
CHECK DAM, TEMPORARY (000)	0	+2	NA	NA	NA	NA	+1	+1	+/-	+2	NA	NA	NA	+1
CHEMICAL STABILIZATION (000)	+1	-1	NA	NA	0	NA	NA	+1	+/-	+2	+2	NA	NA	+/-
CONSTRUCTION ENTRANCE/EXIT PAD, TEMPORARY GRAVEL (930)	+/-	+/-	NA	NA	NA	NA	NA	NA	NA	+1	+1	+2	NA	NA
DE-ICING CHEMICAL USE/STORAGE (000)	NA	NA	NA	NA	+2	NA	NA	+/-	+/-	NA	NA	NA	NA	+1
DETENTION PONDS AND BASINS (000)	+/-	+2	+1	+1	+1	+2	+2	+1	+/-	+2	NA	NA	NA	+1
DETENTION PONDS AND BASINS, EXTENDED (000)	+/-	+2	+1	+1	+1	+2	+2	+1	+1	+2	NA	NA	NA	+1
DIKES/SWALES, INTERCEPTOR (000)	+2	+1	+1	0	+1	+/-	+1	+1	+1	+2	NA	+/-	NA	+/-
DIVERSION DIKE (820)	+2	+2	+1	0	+1	+1	+1	+1	+1	+1	NA	+1	NA	+/-
DIVERSION, PERMANENT (815)	+2	+2	+1	+/-	+1	+1	+1	+1	+1	+1	NA	+1	NA	+/-
DIVERSION, TEMPORARY (955)	+2	+2	+1	+/-	+1	+1	+1	+1	+1	+1	NA	+1	NA	+/-
DUST CONTROL (825)	NA	NA	NA	NA	+1	NA	NA	+/-	+/-	0	+2	+1	NA	+1

Conservation Practice / (NRCS Code)	Sheet & Rill Erosion	Rill & Gully Erosion	Stream-bank Erosion	Stream Channel Erosion	Reduced Toxics & Salt	Flooding	Increased Peak Flow	Nutrient Pollution	Pesticide Pollution	Sediment Damage	Dust Control	Construction Road Maintenance	Water Table Control	Organic Pollution
Energy Dissipaters (000)	+/-	+2	+2	+2	NA	NA	+1	+/-	+/-	+2	NA	+1	NA	+1
Erosion Blanket (830)	+2	+/-	+1	+1	+/-	NA	NA	+1	+/-	+2	+1	NA	NA	+2
Filter Strip, Urban (835)	+2	+/-	+2	NA	+1	NA	NA	+1	+/-	+2	+1	NA	NA	+2
Floatable Skimmers (000)	NA	NA	NA	NA	NA	NA	NA	0	0	+1	NA	NA	NA	+1
Geotextiles (000)	+2	+/-	+/-	NA	+1	NA	NA	0	0	+2	NA	+/-	NA	+1
Grade Stabilization Structure (000)	+/-	+2	+1	+/-	0	0	+1	0	0	+2	NA	+/-	NA	0
Gradient Terrace (000)	+2	+1	+1	NA	0	0	NA	+1	+1	+2	NA	+/-	NA	+/-
Grassed-Lined Channels (840)	+1	+2	+1	+2	0	+1	NA	+1	+/-	+2	NA	+/-	NA	+/-
Gravel/Stone Filter Berm (000)	+2	+2	+2	NA	+/-	NA	NA	+/-	0	+2	NA	+/-	NA	+2
Impoundment Structure - Full Flow (841)	+2	+2	+1	+2	NA	+2	+2	+/-	+/-	+2	NA	NA	+2	0
Impoundment Structure-Routed (842)	+2	+2	+2	+2	+1	+2	+2	+/-	+/-	+2	NA	NA	+2	0
Infiltration Basin (845)	+1	+1	0	0	+1	+1	+2	+/-	+/-	+2	NA	NA	+/-	+2
Infiltration Trench (845)	+1	+1	0	0	+1	+1	+2	+/-	+/-	+2	NA	NA	+/-	+2
Inlet Protection - Block and Gravel (850)	+1	0	0	0	NA	NA	NA	+1	+1	+1	NA	+/-	NA	+1
Inlet Protection - Excavated Drain (855)	+1	0	0	0	NA	NA	NA	+1	+1	+1	NA	+/-	NA	+1
Inlet Protection -Fabric	+1	0	0	0	NA	NA	NA	+1	+1	+1	NA	+/-	NA	+1

Conservation Practice / (NRCS Code)	Sheet & Rill Erosion	Rill & Gully Erosion	Stream-bank Erosion	Stream Channel Erosion	Reduced Toxics & Salt	Flooding	Increased Peak Flow	Nutrient Pollution	Pesticide Pollution	Sediment Damage	Dust Control	Construction Road Maintenance	Water Table Control	Organic Pollution
Drop (860)														
Land Grading (865)	+2	+2	+1	NA	+/-	+1	0	+/-	+/-	+1	NA	+2	NA	+/-
Level Spreader (870)	+1	+1	+1	NA	+/-	0	+/-	+/-	+/-	+1	NA	0	NA	+/-
Lot Benching (000)	+2	+/-	+1	NA	+/-	0	+/-	+/-	+/-	+1	NA	NA	NA	+1
Mulching (875)	+2	+2	+1	NA	+1	NA	+1	+2	+/-	+2	+2	NA	NA	+1
Oil/Grit Separators (000)	NA	NA	NA	NA	NA	NA	NA	NA	+/-	+1	NA	0	NA	+/-
Porous Pavement (890)	+1	+1	+/-	NA	+1	+1	+1	+/-	+/-	+1	NA	+1	+1	+/-
Portable Sediment Trap (895)	0	0	NA	NA	+/-	NA	NA	+1	+/-	+2	NA	+1	NA	+1
Preservation of Natural Vegetation (000)	+2	+2	+2	+/-	+2	+1	+1	+2	+2	+2	NA	+2	NA	+2
Retaining Walls (000)	+2	+2	+2	NA	NA	NA	NA	+2	+2	+1	NA	+1	NA	+2
Right-of-Way Diversion [Water Bars] (900)	+2	+1	+1	NA	+/-	+1	NA	+2	+2	+1	NA	+2	NA	+2
Riprap-Lined Channel (000)	+1	+2	+1	+2	NA	NA	+/-	0	NA	+2	NA	+/-	NA	NA
Rock Dam (000)	+1	+2	+1	+1	NA	+1	+1	0	NA	+1	NA	+1	NA	+1
Rock Outlet Protection (910)	0	+2	+2	+2	NA	+/-	0	NA	NA	+1	NA	+1	NA	NA
Sediment Basin, permanent (000)	+1	+1	+1	+/-	+1	+1	+1	+1	+/-	+2	NA	+1	+/-	+2
Sediment Basin,														

Conservation Practice / (NRCS Code)	Sheet & Rill Erosion	Rill & Gully Erosion	Stream-bank Erosion	Stream Channel Erosion	Reduced Toxics & Salt	Flooding	Increased Peak Flow	Nutrient Pollution	Pesticide Pollution	Sediment Damage	Dust Control	Construction Road Maintenance	Water Table Control	Organic Pollution
Temporary (960)	+1	+2	+/-	NA	+/-	0	+1	+/-	+1	+2	NA	+2	NA	+2
Sediment Trap, Temporary (960)	+1	+2	+/-	NA	+/-	0	+1	+/-	+1	+2	NA	+2	NA	+2
Seeding, Permanent (880)	+2	+2	+2	NA	+2	+2	+2	+2	+2	+2	+2	+2	NA	+2
Seeding, Temporary (965)	+2	+2	+2	NA	+2	+2	+2	+2	+2	+2	+2	+2	NA	+2
Silt Curtain, Flotation (000)	NA	NA	NA	NA	+1	NA	NA	+2	+/-	+2	NA	NA	NA	+2
Silt Fence (920)	+2	+2	0	NA	+1	NA	+1	+1	0	+2	+/-	+2	NA	+2
Slope Drain, Temporary (970)	0	+2	NA	NA	+1	+/-	+/-	+/-	+/-	+1	NA	+1	+2	+/-
Sodding (925)	+2	+2	+2	NA	+1	+2	+2	+2	+2	+2	+2	+1	NA	+2
Soil Bioengineering for Slope Protection (000)	+2	+2	+2	NA	NA	NA	NA	+2	+2	+2	0	NA	NA	+1
Stabilized Construction Entrance/Exit Pad (930)	+1	+/-	NA	NA	NA	NA	NA	NA	NA	+1	0	+2	NA	NA
Stormwater Wetland, Urban (800)	+1	+1	+1	+2	+2	+2	+2	+2	+1	+2	NA	NA	+2	+2
Straw Bale Barrier (935)	+2	+2	NA	NA	NA	NA	NA	+1	+1	+2	0	+2	NA	+2
Stream Crossing, Temporary (975)	NA	NA	+1	+1	NA	NA	-2	NA	NA	NA	+2	+/-	NA	NA
Streambank Stabilization (940)	NA	+2	+2	+2	0	NA	+/-	+2	+2	+2	+/-	NA	NA	+2
Streambank Setback (000)	+2	+2	+2	+2	0	+2	+2	+2	2+	+2-	+/-	NA	NA	+2

Conservation Practice / (NRCS Code)	Sheet & Rill Erosion	Rill & Gully Erosion	Stream-bank Erosion	Stream Channel Erosion	Reduced Toxics & Salt	Flooding	Increased Peak Flow	Nutrient Pollution	Pesticide Pollution	Sediment Damage	Dust Control	Construction Road Maintenance	Water Table Control	Organic Pollution
Subsurface Drain (945)	+1	+1	+2	-2	+2	+1	+2	+/-	+/-	+1	NA	+2	+2	+2
Sump Pit (950)	NA	NA	NA	NA	+2	NA	NA	+2	+2	+2	NA	NA	+2	+1
Surface Roughening (000)	+2	+/-	+1	+1	+/-	NA	NA	+2	+1	+2	+1	NA	NA	+/-
Swale, Temporary (980)	+/-	+1	+/-	+1	+/-	+1	NA	+/-	+/-	+1	NA	+1	NA	+1
Top Soiling (981)	+2	+1	+1	NA	+2	+1	+1	+1	+1	+1	+1	NA	NA	+2
Tree and Shrub Planting (985)	+2	+2	+2	+2	+2	+1	+2	+2	+2	+2	+2	NA	+2	+2
Tree and Shrub Protection (990)	+2	+2	+2	+2	NA	+2	+1	+2	+2	+1	+2	NA	+1	+2
Vegetative Streambank Stabilization (995)	+2	+2	+2	+2	NA	NA	+1	+1	+1	+1	+2	NA	+1	+2
Good Housekeeping Practices														
Accidental Spills (000)	NA	NA	NA	NA	+2	NA	NA	+1	+1	NA	NA	NA	NA	+1
Concrete Trucks (000)	NA	NA	NA	NA	+2	NA	NA	NA	NA	NA	NA	NA	NA	+1
Contaminated Soils (000)	NA	NA	NA	NA	+2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Control of Allowable Non-Storm Water Discharges (000)	+/-	+1	+1	+1	NA	+2	NA	NA	NA	+2	NA	NA	NA	+2

Conservation Practice / (NRCS Code)	Sheet & Rill Erosion	Rill & Gully Erosion	Stream-bank Erosion	Stream Channel Erosion	Reduced Toxics & Salt	Flooding	Increased Peak Flow	Nutrient Pollution	Pesticide Pollution	Sediment Damage	Dust Control	Construction Road Maintenance	Water Table Control	Organic Pollution
Construction Wastes (000)	NA	NA	NA	NA	+2	NA	NA	+1	NA	NA	NA	NA	NA	+2
Dewatering (000)	NA	NA	NA	NA	+2	+2	NA	NA	NA	NA	NA	NA	+2	NA
Fertilizers/Detergents (000)	NA	NA	NA	NA	+2	NA	NA	+2	NA	NA	NA	NA	NA	+2
Hazardous Wastes (000)	NA	NA	NA	NA	+2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Litter Control (000)	NA	NA	NA	NA	+2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Natural Geologic Drainage (000)	NA	NA	+1	+1	NA	+1	+1	NA	NA	NA	NA	NA	+2	NA
Pesticides (000)	NA	NA	NA	NA	+2	NA	NA	NA	+2	NA	NA	NA	+2	NA
Petroleum Products (000)	NA	NA	NA	NA	+2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sandblasting Grits (000)	NA	NA	NA	NA	+2	NA	NA	NA	NA	+1	+2	NA	NA	+2
Sanitary/Septic Disposal (000)	NA	NA	NA	NA	+2	NA	NA	+2	NA	NA	NA	NA	NA	+2
Sump Pit (000)	NA	NA	NA	NA	NA	+1	NA	NA	NA	NA	NA	NA	NA	NA
Waste Disposal (000)	NA	NA	NA	NA	+2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inspections	+2	+2	+2	+1	+2	+1	+2	+2	+2	+2	+2	+2	+2	+2
Maintenance	+2	+2	+2	+1	+2	+1	+2	+2	+2	+2	+2	+2	+2	+2
Recordkeeping	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2

URBAN CONSERVATION PRACTICES
FOR
WATER QUALITY
(10/28/98)

Buffer Zone/Strip

Buffer zones are vegetated strips of land used for temporary or permanent water quality benefits. Buffer zones are used to decrease the velocity of storm water runoff, which in turn helps to prevent soil erosion. Buffer zones are different from vegetated filter strips because buffer zone effectiveness is not measured by its ability to improve infiltration (allow water to get into the ground). The buffer zone can be an area of vegetation that is left undisturbed during construction, or it can be newly planted. Establishing new buffer zones requires the establishment of good dense turf, trees, and shrubs. Buffer zones are particularly effective on floodplains, next to wetlands, streambanks, lakes, drinking water reservoirs, and on steep, unstable slopes. Buffer zones provide multiple benefits, improved wildlife habitat, increased water infiltration, better runoff water quality, improved recreation, increased aesthetic values, and reduced sediment from sheet, rill and gully erosion. Careful maintenance is important to ensure healthy vegetation. The need for routine maintenance such as mowing, fertilizing, liming, potential irrigation, pruning, and weed and pest control will depend on the species of plants and trees selected, soil types, and climatic conditions. Maintenance of plantings requires occasional debris removal and protection.
[*Riparian Forest Buffer (391); Streambank and Shoreline Protection (580); Wildlife Upland Habitat Management (645); Wildlife Wetland Habitat Management (644)*]

Catch Basin Cleaning

Catch basins are chambers or sumps installed in underground stormwater drains, usually at the curb, which allow surface water runoff to enter and trap coarse sediment and solid debris from passing through the drain into receiving waters. Clean-out of the basins (traps) is required periodically to be effective. The basins benefit water quality by reducing sediment loading, and trapping oxygen-demanding substances from reaching surface waters. Typical catch basins are designed to retain 0.5-1.5 cubic yards of materials. If not cleaned on a regular basis, surface water quality could actually become worse once the basin reaches 40-50% design capacity due to increased turbulence from the inflow through flushing of captured sediment and the materials that have decayed while trapped in the basin. Properly designed basins are known to trap 57% of coarse solids and 17% of the equivalent BOD. This practice is effective during and after land disturbance activities.

Check Dams (Temporary)

A check dam is a small, temporary or permanent dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows. Reduced runoff speed reduces erosion and gully formation in the channel thus allowing sediments to settle out. It is installed in steeply sloped swales or in swales where adequate vegetation cannot be established. Check dams may be built from logs, stone, or pea gravel-filled sandbags. This should be used only in small open channels which will not be overtopped once the

dam(s) are constructed. [***It should be noted that it is illegal in Missouri to use streams as a treatment device***.] The center section of the dam should be lower than its edges. Dams should be spaced so the toe of the upstream dam is the same elevation as the next downstream dam top. Frequent inspections and regular maintenance are critical to the operation of this measure. Remove sediment once 50% of the storage area behind the check dam is filled

Chemical Stabilization

Chemical stabilization practices, often referred to as a chemical mulch, soil binder, or soil palliative are temporary erosion control practices. Emulsion materials made of vinyl, anionic asphalt, latex, resin in water, acrylic, non-acrylic or rubber sprayed onto the surface of the soil to hold the soil in place and protect against erosion from stormwater runoff and wind. Many of the products used for chemical stabilization are human-made, and many different products are on the market. Chemical stabilization can be used as an alternative where temporary seeding practices cannot be used because of soil or climate. It can provide immediate, effective, and inexpensive erosion control anywhere erosion is occurring on a site. Follow the manufacturer recommended application rates for chemical stabilization products and to prevent the products from forming ponds and creating large areas where moisture cannot penetrate into the soil below.
[*Mulching (484); Critical Area Seeding (342)*]

Construction Entrance/exit Pad, Temporary Gravel (930)*

A stone base designed to provide a buffer area where construction vehicles can drop their mud to avoid transporting it onto roads. This practice applies anywhere traffic will be leaving a construction site and moving directly onto a public road or other paved area. This may be used in combination with other practice measures to accomplish the specific site or area needs. This should not be used as an equipment washing site unless special provisions have been made for the collection of wash-water before reaching the public road or other paved area. A permit may be required if such wash water is not properly collected and treated by a public water treatment system facility.
[*Access Road (560)*]

De-icing Chemical Use and Storage

Tremendous amounts of de-icing chemicals are used each winter on roads, sidewalks, and parking lots (such as sodium chloride or salt). Proper use and storage of de-icing agents will reduce the chance of high chloride concentrations in runoff water that may reaching surface water and damaging the environment. Although salt is the main pollutant addressed in this standard, trace metals have also been found to be associated with the use of agents for de-icing. It has been estimated that 80% of the environmental damage from de-icing chemicals is caused from inadequate storage facilities. Prevention of over application of de-icing chemicals will reduce quantities of chloride from entering stormwater runoff as a pollutant. Stockpiles should be completely contained under a roof or cover with a water repellant cover. Calibrating equipment is another means of reducing over application. Apply only to areas where eminent danger exists to safe traffic passage (curves, inclines, or heavy traffic intersections). Low use roadways should have minimal use of de-icing chemicals.

Detention Ponds and Basins*

Detention ponds and basins are designed to hold stormwater runoff and release the water slowly to prevent downstream flooding and stream erosion. Detention ponds and basins are an extremely effective water quality control measure and significantly reduce the frequency of erosive floods downstream. Ideally, a detention pond will store at least the first 2 inch of runoff from the design storm and release the remainder at or below the pre-development rate. The design includes a permanent pool of water (retention). Their usage is suited to larger drainage areas of 20-50 acres in more intensively developed areas. Regular detention ponds have less storage and different conduits than extended detention ponds. Both can have a permanent pool of water or a dry basin and can have sediment storage held as part of the design. This practice has a storm runoff detention time of 24-48 hours and a life-span of 10-20 years. This practice is enhanced with other complementary measures. Clean out should be regularly scheduled. Personal safety such as fencing should be installed to protect small children in urban settings. Structures must meet all local, state and federal dam safety requirements.
[*Grade Stabilization Structure (410); Structure for Water Control (578); Ponds (378); Sediment Basin (350)*]

Detention Ponds and Basins, Extended*

A dam designed to hold stormwater runoff for a prolonged time and release the water slowly to prevent downstream flooding, stream erosion, and pollution. Extended detention ponds and basins improve the quality of runoff by retaining potential chemical-laden sediment. They also significantly reduces the peak flow rate from flood events, thus reducing the frequency of erosive floods downstream. Ideally, an extended detention pond will store the first one inch of runoff and release the remainder at or below the pre-development rate. This is best suited to large, intensively developed sites with a drainage area of 20-100 acres. Extended detention ponds differ from regular detention ponds by increasing the storage volume. Both can have permanent pools of water (retention basin) or dry basins and can be designed to hold sediment. The detention time is designed for 24-72 hours and a life-span of 10-20 years. A designed length to width ratio of 3:1 or greater maximizes the trapping efficiency. This practice is enhanced by using complementary measures to improve water quality effectiveness. Clean out should be regularly scheduled. Personal safety such as fencing should be installed to protect small children in urban settings. Structures must meet all local, state and federal dam safety requirements.
[*Grade Stabilization Structures (410); Structure for Water Control (578); Ponds (378); Sediment Basin (350)*]

Dikes & Swales, Interceptor

Interceptor dikes (ridges of compacted soil) and swales (excavated depressions) are used to keep upslope runoff from crossing areas where there is a risk of erosion. They reduce the amount and speed of flow and then guide it to a stabilized outfall (point of discharge) or sediment trapping area. Interceptor dikes and swales divert runoff using a combination of earth dike and vegetated swale. Runoff is channeled away from locations where there is a high risk of erosion by placing a diversion dike or swale at the top of a sloping

disturbed area. Dikes and swales also collect overland flow, changing it into concentrated flows. Interceptor dikes and swales can be either temporary or permanent storm water control structures. These are generally built around the perimeter of a construction site before any major soil disturbing activity takes place. They may be used to protect existing buildings, stockpiles, and other areas not fully stabilized. Temporary dikes or swales constructed on the downslope side of the disturbed or high-risk area will prevent runoff that contains sediment from leaving the site before sediment is removed. When constructed along the upslope perimeter or a disturbed or high-risk area, dikes and swales prevent runoff from the upslope area from entering the unprotected or critical area. For short slopes, a dike or swale at the top of the slope reduces the amount of runoff entering the disturbed area. For longer slopes several dikes and swales will be needed. In all cases the surface water runoff is guided to a sediment trapping basin and has a stabilized outlet.
[*Diversion (362)*]

Diversion Dike (820)

A diversion dike is a berm, dike or dike and channel constructed along the perimeter of a disturbed construction area. The purpose of this practice is to prevent storm runoff from entering the work area or to prevent sediment-laden runoff from entering the construction site without first passing through a sediment trapping device. The dike consists of compacted soil and stone, riprap, or vegetation to stabilize the channel. Dikes are used in construction areas to control sediment, erosion, or flood damage. Dikes can be used in site conditions such as 1) above disturbed existing slopes and above cut or fill slopes to prevent runoff over the slope; 2) across unprotected slopes, as slope breaks, to reduce slope length; 3) below slopes to divert excess runoff to stabilized outlets; 4) to divert sediment-laden water to sediment traps; 5) at or near the perimeter of the construction area to keep sediment from leaving the site; 6) above disturbed areas before stabilization to prevent erosion and maintain acceptable working conditions; and 7) temporary diversions that serve as a sediment trap when the site has been over-excavated on a long flat or in conjunction with a sediment/silt fence. Diversion dikes do not usually encircle the area. This is a special application of a temporary or permanent diversion, but it differs in its location, the grade is usually fixed, and the cross-section and stabilization requirements are based on the existing grade. Limit drainage areas to 5 acres or less; avoid erosive velocities in steep areas; and identify areas of excessive sediment buildup since this can cause unnecessary overtopping and potentially greater downstream damage.
[*Dike (Earthen) (356*)]

Diversion, Permanent (815)*

A permanent watercourse (channel, ridge, or a channel and supporting compacted ridge), constructed across the slope to collect and divert runoff. The purpose of this practice is to divert excess surface water from one area for use or safe disposal in other areas where it can be temporarily stored or released to a stable outlet. This permanent site development practice applies to areas where runoff can be diverted and used or disposed of safely to prevent localized flood damage, excessive wetness, erosion, to allow establishment of down slope vegetation, or reduce sediment damage. It should be

installed 1) above steep slopes to limit surface runoff onto the slope; 2) across long slopes to reduce slope length to prevent gully erosion; 3) below steep grades where flooding, seepage problems, or sediment depositions may occur; or 4) around buildings or areas that are subject to damage from runoff. Designs should be limited to drainage areas of 5 acres or less.
[*Diversion (362)*]

Diversion, Temporary (955)*

A temporary ridge or excavated channel or combination designed and installed across sloping land on a predetermined grade. The practice protects work areas from upslope runoff and diverts sediment-laden water to an appropriate sediment trapping facility or stabilized outlet. This applies to construction areas where runoff can be temporarily diverted to control erosion, sediment retention onsite, or flood damage. Specific locations or conditions include: 1) above disturbed existing slopes, and above cut or fill slopes to prevent runoff over the slope; 2) across unprotected slopes (slope breaks) to reduce slope length; 3) below slopes to divert excess runoff to stabilized outlets; 4) where needed to divert sediment-laden water to sediment traps; 5) at or near the perimeter of the construction area to keep sediment from leaving the site; 6) above disturbed areas before stabilization to prevent erosion and maintain acceptable working conditions; 7) a drainage area of 5 acres or less; 8) used for less than 18 months; and 9) where active construction activities make the use of a permanent practice unfeasible.
[*Diversion (362)*]

Dust Control (825)*

Controlling dust blowing and movement on construction sites includes a wide range of techniques that reduce movement of wind-borne soil particles and other potential pollutants from soil surfaces. The purpose of this practice is to prevent blowing and movement of dust from exposed soil surfaces, reduce on-site and off-site damage, minimize health hazards, improve traffic, and improve personal safety. This practice is applicable to areas subject to dust blowing and movement where damage is likely without treatment (e.g. construction routes). Dust control can be achieved using one or more of these methods; 1) mulches (including gravel mulch); 2) vegetative cover; 3) spray-on adhesives (chemical stabilization); 4) tillage; 5) irrigation, 6) wind barriers; 7) calcium chloride; 8) stone; 9) street cleaning; or 10) permanent vegetation. As the distance across bare soil increases wind erosion becomes more severe. Consequently, rainfall infiltration in this area becomes more difficult creating a moisture deficit which will inhibit vegetative establishment and increase surface water runoff and erosion. Mulching when used in this situation conserves moisture, prevents surface crusting, reduces runoff and erosion, and enhances the environment for seedling vegetative growth. This is very critical on sloping lands.

Energy Dissipaters*

This practice is designed to prevent erosion at the outlet of a channel or conduit by reducing the velocity of flow and dissipating the energy. Energy dissipaters usually consist of riprap-lined aprons, plunge pools, a reinforced concrete flume with concrete baffles, a reinforced concrete box with chambers or baffles or in combination with

riprap. This practice applies where high velocity discharge must be released on erodible material. Outlet protection may require the use of a plunge pool to dispel more energy with greater efficiency when used in combination with designed aprons. Energy dissipaters need to be designed by a professional consultant that is site specific, with zero grade aprons, plunge pools, and no outfall at the apron end.

Erosion Blanket (830)*

This practice refers to the application of a manufactured protective blanket of straw, jute, wood or other plant fibers, plastic, nylon, paper or cotton fibers formed into a mat, usually with a mesh on one or both sides of the mat. Many products today are pre-packaged with mulch, fertilizer, and seed in the mat for ease of placement. The purpose of this practice is to protect the soil surface from raindrop impacts and overland flow during the establishment period of grass or other vegetation. It also reduces soil moisture loss due to evaporation. The practice should be used for the protection of a newly seeded area with critical short steep slopes, where the hazard is high, and the plant growth is likely to be slow in providing adequate cover. This is especially important where flowing water may occur before the grass is established. Erosion control blankets are typically used as an alternative to mulching but can be used to provide structural erosion protection. The most common application is in the bottoms of small channels (velocities up to 12 cubic feet per second) and on steep embankments (slopes up to 1:1). This practice is used in combination with other practices such as permanent seeding.
[*Critical Area Seeding (342); Mulching (484)*]

Filter Strip, Urban (835)

A filter strip is an area created of vegetation designed to remove sediment and other pollutants only from surface water runoff. The purpose is to remove sediment and other pollutants from runoff water by slowing the water down to allow filtration, deposition, infiltration, adsorption, reduced velocities, reduced overland flows, and vegetative uptake. This practice may be applied in a variety of uses where surface water runoff is discharged as overland sheet flow. [This does not apply to high velocity runoff or concentrated flows.] It is limited to a drainage area, 5 acres or less, with a minimum width of 50 feet plus an additional 4 feet for each 1% slope increase over a 5% slope up to a maximum of 15% slope. Filter strip widths differ for grassed versus wooded areas. This is used in combination with other measures. Some typical locations of vegetated filter strips include: 1) on construction sites and land undergoing development where filter strips are needed at the lower edge of disturbed areas to reduce damage from overland (sheet) flow to adjacent property; 2) above or adjacent to wetlands, streams, ponds, lakes, or conservation areas used to store, manage, or convey water, where shallow sheet-flow conditions can be maintained to reduce sediment and associated materials; and 3) adjacent to roadways, parking lots, and other impervious surfaces to disconnect them from streams and other water resources.
[*Filter Strip (393)*]

Floatable Skimmers

Floatable skimmers are devices used to retain floating debris and oil in detention areas. The floating debris and oil eventually sink to the bottom of the detention area and

become part of the sediment or are removed from the surface through regular maintenance. It is useable for trapping floating organic matter and oils which contain nutrients, oxygen-demanding substances and hydrocarbons. The effectiveness of any skimmer depends upon the amount and type of floating materials transported by the runoff. In areas with excessive leaves, oils, or trash, this practice can prove very beneficial to water quality. These devices are normally attached to vertical outlets, corrugated metal outlets, or baffled weir outlets. Maintenance is required after each stormwater runoff event to maintain flow efficiency.

Geotextiles

Geotextiles are porous fabrics known in the construction industry as filter fabrics, road rugs, synthetic fabrics, construction fabrics, or simply fabrics. Geotextiles are manufactured by weaving or bonding fibers made from synthetic materials such as polypropylene, polyester, polyethylene nylon, polyvinyl chloride, glass, and various mixtures of these. As a synthetic construction material, geotextiles are used for a variety of purposes. The uses of geotextiles include separators, reinforcement, filtration and drainage, and erosion control. Some geotextiles are also biodegradable materials such as mulch matting and netting. Mulch mattings are materials (jute or other wood fibers) that have been formed into sheets of mulch that are more stable than normal mulch. Netting is typically made from plastic, paper, cotton, jute, or other wood fiber that can be used to hold mulching and matting together on the ground surface. It also can be used alone to stabilize soils while the plants are growing; however, some do not retain moisture or temperature well. Mulch binders (either asphalt or synthetic) are sometimes used instead of netting to hold loose mulches together on the soil surface. Geotextiles can be used for erosion control alone (as a matting) to stabilize the soils at the bottom of channels or swales where surface water runoff concentrates; used to protect long slopes during vegetative establishment; and on streambanks where moving water is likely to wash out new planting. When used as a separator (under riprap, sand and gravel) the separation between the two mediums prevents soil or sand from migrating into the protective layer and from allowing soil erosion from under the protective layer. Effectiveness is dependent upon firm, continuous matting in direct contact with the soil surface and the materials used. The various types of geotextiles are numerous so the selected fabric must match the intended application.
[*Critical Area Seeding (342); Mulching (484)*]

Grade Stabilization Structure

A grade stabilization structure is a permanent structure or series of structures designed to drop surface water runoff to a lower elevation without erosion. Grade stabilization structures are commonly used when discharges from a stormwater conveyance channel (grassed waterway) or diversion must be dropped to a lower elevation receiving channel. These structures can also be used within channels to flatten the channel grade thereby reducing velocities. Grade stabilization structures can prevent gully erosion caused by overfalls or unstable soil in channels. Structures of this type can be designed with many types of materials and require a professional design person. Since these structures easily attract children and curious adults, safety features (fences, trash grids, or signs) need to be incorporated to avoid unnecessary harm.

[*Grade Stabilization Structure (410)*]

Gradient Terrace

Gradient terraces are earth embankments or ridge-and-channels constructed along the face of a slope at regular intervals. Gradient terraces are constructed at a positive grade. They reduce erosion damage by capturing surface runoff and directing it to a stable outlet at a speed that minimizes erosion. Gradient terraces are usually limited to use on long, steep slopes with a water erosion problem, or where it is anticipated that water erosion will be a problem. They should not be constructed on slopes with sandy or rocky soils. They are effective only when suitable runoff outlets are stable or will be installed. Adequate outlets could be grassed waterways, stable vegetated area, or a tile outlet. Terrace outlets should have a free flowing outlet, not submerged so as to force storage of surface runoff behind the terrace.
[*Terrace (600)*]

Grass-lined Channels (840)

A natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for conveyance of runoff to a stable outlet. The purpose of a grassed-lined channel is to convey and dispose of concentrated surface runoff without damage from erosion, deposition, or flooding. The practice applies to construction sites and developing areas where: 1) concentrated runoff will cause damage from erosion or flooding; 2) sufficient depth of soil materials to allow establishment of vegetation that will stabilize the cross section and grade of the channel; 3) channel grades are generally less than 5% slope; and 4) space is available for a relatively large cross section. Typical uses include roadside ditches, diversions outlets, and other channels and drainage swales to stabilize concentrated flows.
[*Grassed Waterway (412)*]

Gravel/Stone Filter Berm

A gravel or stone filter berm is a temporary ridge constructed of loose gravel, stone, or crushed rock. It slows and filters flow, diverting it from an exposed traffic area. Diversions constructed of compacted soil may be used where there will be little or no construction traffic within the right-of-way. They are also used for directing runoff from the right-of-way to a stabilized outlet. This method is appropriate where roads and other right-of-ways under construction accommodate vehicular traffic. Berms are meant for use in areas with gentle slopes and may also be used at traffic areas within the construction site. Spacing of berms is dependent upon slope steepness and length. Life-span is limited and requires frequent inspections and costly maintenance. Maintenance requires removal of sediment collected and replacing the stone/gravel berm to original design.

Impoundment Structure-Full Flow (841)

A dam or excavation which creates an impoundment to collect or store debris, sediment, or water. The purpose of this practice is to reduce sediment and/or debris in runoff waters preventing damage to downstream facilities, stream channels or banks, or to provide surface water for consumption, irrigation, wildlife habitat, recreation or fire

protection. The practice applies where sediment or debris is expected to be contained in runoff waters that may impair the capacity of the watercourse or damage other structures or where a surface water supply is desirable; where storage for at least one inch of water from the contributing watershed is either impractical or undesirable and where any embankment does not exceed the limits for dam classification and the landowner or responsible party has secured permits, if required, from federal, state and local governmental authorities.
[*Grade Stabilization Structure (410); Structure for Water Control (578); Ponds (378)*]

Impoundment Structure-Routed (842)

A dam or excavation which creates an impoundment to collect and store debris, sediment, or water. The purpose of this practice is to reduce sediment and/or debris in runoff waters preventing damage to downstream facilities or to provide surface water for consumption, irrigation, wildlife habitat, recreation or fire protection. The practice applies where sediment or debris is expected to be contained in runoff waters that may impair the capacity of the watercourse or damage other structures, or where a surface water supply is desirable, where storage for at least one inch of water from the contributing watershed is either impractical or undesirable and where any embankment does not exceed the limits for dam classification and the landowner or responsible party has secured permits, if required, from federal, state and local governmental authorities.
[*Grade Stabilization Structure (410); Ponds (378); Structure for Water Control (578)*]

Infiltration Basin (845)*

A dam designed to detain stormwater allowing it to slowly filter through the soil. Infiltration basins can be constructed to reduce the peak flow rate from the design storm, recharge groundwater in the vicinity of the basin, filter potential contaminants, and sustain flows during low stream flow periods. The basins are effective in removing contaminants from stormwater runoff in urban settings. Infiltration basins should be designed for each specific site. This practice is best used in larger intensively developed sites of 15 acres or less. Design criteria must include detention time ranges are from 24-72 hours; suitable soils with permeability ranges from 0.5 to 2.4 inches per hour to ensure proper infiltration and treatment of runoff; soils with less than 30% clay and less than 40% silt content; the basin floor should be nearly level; a stable outlet for the excess discharge; a plan to monitor for potential groundwater contamination; and a separation of 2-4 feet from the seasonal water table to avoid potential contamination.
[*Sediment Basin (350); Structure for Water Control (578); Grade Stabilization Structure (410)*]

Infiltration Trench (845)*

A shallow excavated trench backfilled with clean gravel or stone which intercepts stormwater runoff for temporary storage and infiltration. This practice reduces runoff volume and peak discharges from a site and filters contaminants out of runoff before it reaches the receiving waters in urban settings. Sediments must be filtered before the runoff water enters the trench using a designed filter strip. Infiltration trenches provide a good avenue to recharge groundwater in the local vicinity with permeable soils having silt and clay content below 40%. This permanent practice applies to small drainage areas,

usually 5 acres or less and sites with soils in the hydrologic groups A and B. Soils in hydrologic groups C and D will not perform adequately unless on a very small acreage. Infiltration trenches intercept internal drainage thus the need for an overflow outlet. All infiltration trenches need an overflow component since the trenches are not designed to handle large runoff volumes. These trenches require careful design and installation along with regular maintenance. Infiltration trenches are constructed 3 to 8 feet deep, lined with filter fabric, a sand filter, and backfilled with clean stone or gravel. Design for detention should have a range from 24-72 hours storing 2 inch of runoff/ impervious acre or the runoff volume from a 1 inch storm from the drainage area (maximum of 5 acres per designed trench) and the trench bottom a minimum of 2-4 feet above the seasonal high water table
[*Subsurface Drainage (606); Underground Outlet (620)*]

Inlet Protection-Block and Gravel (850)*
This is a sediment control barrier formed around a storm drain inlet using standard block and gravel. The purpose is to help prevent sediment from entering storm drains before the disturbed construction area is permanently re-vegetated and stabilized. This practice applies where early use of the storm drainage system is necessary. This method of inlet protection is effective where the inlet drains a small, nearly level area with contributing slopes generally less than 5%, where shallow sheet flows not exceeding 1 cubic feet per second are expected and the drainage area does not exceed 1 acre. The immediate land area around the inlet should be relatively flat, less than 1% slope, and located so that accumulated sediment can be easily removed. [This should not be used in areas receiving concentrated flows such as in street or highway medians.] Inlet protection is used in combination with other soil stabilizing measures to provide most effective sediment removal and longevity of the practice. Repairs and sediment removal should be performed on a regular schedule. Removal of such practices should not occur until the contributing drainage area is completely stabilized.

Inlet Protection-Excavated Drain (855)*
This is an excavated area used in the approach to a storm drain drop inlet or curb inlet. The purpose of this practice is to prevent sediment from entering storm drains before the contributing watershed is stabilized and allows early use of the storm system. This method is applicable where small storm events with relatively high sediment-laden flows are expected. Inlet design is for overflow capability and ease of maintenance are desired. This method of inlet protection is effective where the inlet drains a small, nearly level area with slopes generally less than 5%, where shallow sheet flows not exceeding 1 cubic feet per second are expected and the drainage area must not exceed 1 acre. The immediate land area around the inlet should be relatively flat, less than 1% slope, and located so that accumulated sediment can be easily removed. Frequent maintenance is required and temporary flooding in the excavated area will occur. [This should not be used in areas receiving concentrated flows such as in street or highway medians.] Inlet protection is used in combination with other soil stabilizing measures to provide most effective sediment removal and longevity of the practice. Repairs and sediment removal should be performed on a regular schedule. Removal of such practices should not occur until the contributing drainage area is completely stabilized.

Inlet Protection-fabric Drop (860)*

This is a temporary woven geotextile fabric barrier placed around a drop inlet. The purpose of this practice is to help prevent sediment from entering storm drains during construction operations. This practice allows early use of the storm drainage system. A fabric drop type inlet protection may be used where storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. This method of inlet protection is effective where the inlet drains a small, nearly level area with slopes generally less than 5%, where shallow sheet flows not exceeding 1 cubic feet per second are expected and the drainage area must not exceed 1 acre. The immediate land area around the inlet should be relatively flat, less than 1% slope, and located so that accumulated sediment can be easily removed. [This should not be used in areas receiving concentrated flows such as in street or highway medians.] Inlet protection is used in combination with other soil stabilizing measures to provide most effective sediment removal and longevity of the practice. Repairs and sediment removal should be performed on a regular schedule. Removal of such practices should not occur until the contributing drainage area is completely stabilized.

Land Grading (865)*

Reshaping the ground surface to planned grades providing suitable topography for buildings, facilities and other land uses as determined by an engineered survey, evaluation, and layout. The purpose of this practice is to provide suitable topography for buildings, facilities, and other land uses to control surface runoff and minimize soil erosion and sedimentation both during and after construction. This practice is applicable where grading to a planned elevation is necessary to modify the site for the proposed development of a site and for proper operation of sedimentation control practices. Where practical, adapting the site to the existing landscape is preferable to reduce soil erosion and costly erosion and sediment control measures. Complementary practices that aid slope breaks include diversions (terraces or benches), temporary diversions, level spreaders, and slope drains (temporary or permanent) to reduce soil erosion on long continuous slopes.

[*Land Smoothing (466)*]

Level Spreader (870)

A non-erosive outlet for concentrated runoff constructed to disperse flow uniformly across a slope. The purpose of this practice is to convert concentrated flow to sheet flow and release it uniformly over a stabilized area. This practice is applicable where 1) sediment-free storm runoff can be released in sheet flow down a stabilized slope without causing erosion; 2) where a level lip can be constructed in a cut; 3) where the area above the spreader lip is uniform with a slope of 10% or less and is stable for anticipated flow conditions, preferably well-vegetated; 4) where the runoff water will not re-concentrate after release; and 5) where there will be no traffic over the spreader.

[*Diversion (362); Terraces, Level (600)*]

Lot Benching

Lot benching is the grading of lots within a subdivision so that the runoff from each lot is directed to a stable outlet rather than to an adjacent lot. This practice is applicable to subdivision developments on hilly or sloping topographic sites. Lot benching will reduce the slope and length of slope of disturbed areas within the development, thereby reducing the erosion potential. This practice establishes man-made drainage patterns on individual lots at the time of rough grading and later preventing drainage and siltation problems during construction. The degree of benefit depends upon the complementary conservation practices applied in combination with this practice such as seeding, mulching, waterways, and/or roadway swales. Lots benched on the upslope side of a lot with a 6% slope and 150 feet in length can achieve a reduction in sediment of 85%.

Mulching (875)*

The application of plant residues such as straw, grass, hay, wood chips, gravel, or other suitable materials to the soil surface. The purpose of this practice is as follows: 1) to prevent erosion and prevent surface compaction or crusting by protecting the soil surface from raindrop impact and reducing the velocity of overland flow; 2) to foster the growth of vegetation by conserving available moisture and providing insulation against extreme heat and cold; 3) to improve the site aesthetics; 4) to help maintain the infiltration capacity of the soil and 5) to control weeds. The practice is applied either as a temporary or permanent mulch. Temporary mulches are used to provide protection during temporary or permanent seeding establishment, such as when the season precludes seedling growth; for dust or mud control; and provide protection to areas during periods of construction when a seeding cannot be completed. Permanent mulches are used together with planting of trees, shrubs and other ground cover plants where vegetation does not provide adequate soil erosion protection, or it is used in lieu of vegetative planting for ornamental reasons or because the site is unsuitable for vegetation. Care must be exercised in selection and purchase of weed-free mulch so as to not introduce unknown noxious weeds. Mulches when used in combination with seeding or planting aids in plant growth by modifying the growing environment and holds the seeds, fertilizers and topsoil in place. Use of a mulch may require a binder, netting, or a tacking substance to hold the mulch close to the soil surface. Mulch slopes of 2:1 or steeper, where runoff is flowing across the area, or when seedlings need protection from adverse growing conditions. Hydro-mulching commonly used with hydro-seeding as alternative to sodding or in hard to reach areas for standard seeding and mulching equipment. Hydro-mulching uses wood fiber or other cellulosic fiber such as processed newspaper to produce a uniform fibrous state. It generally is sprayed onto the soil surface as a slurry in water along with seed, fertilizer, lime, binders, and any other additives kept in suspension by agitation

[*Mulching (484)*]

Oil/grit Separators

Oil/grit separators are chambers designed to remove sediment and hydrocarbons from urban runoff. These are used close to the source of potentially contaminated runoff before being conveyed to stormwater drains or infiltration trenches/basins. Separators are generally used where heavy traffic or high potential for petroleum spills can occur such

as parking lots, gas stations, roads, and loading areas. The separators remove floating oil and coarse sediments from runoff. Detention is brief thus removal has limited effectiveness. Soluble pollutants will most frequently pass through the separators. Separators most commonly are installed below the surface, close access to stormwater drains, and have easy access for maintenance. Separators are designed with three chambers with 400 cubic feet/surface area drained. More recent separators use a synthetic medium that has a greater attraction for floating oils and solubles substances, however, it is more costly to maintain.

Porous Pavement (890)

A pavement consisting of strong structural materials having regularly interspersed void areas which are filled with pervious materials, such as sod, gravel, or sand. The purpose of this practice is to reduce water pollution from low-volume traffic areas by providing a bearing surface having adequate strength to accommodate vehicles while allowing infiltration of surface water and filtration of pollutants. The practice is intended to achieve this purpose by 1) reducing volume and peak rate of runoff flow, thus reducing the likelihood of stormdrain overflows, flooding, and downstream erosion and sediment deposition and 2) reducing the loading and concentration of pollutants in the runoff. This applies to the following conditions where the underlying soil allows for rapid drainage but does not contaminate underground water. It may be used in 1) parking lots especially fringe or overflow areas; 2) parking aprons, taxiways, blast pads, and run-way shoulders at airports; 3) emergency stopping and parking lanes and vehicle cross-overs on divided highways; 4) off-street parking aprons in residential settings; 5) recreational vehicle camping area parking pads; 6) private roads, easement service roads, and fire lanes; 7) industrial storage yards and loading zones (heavier loads may demand use of reinforced grid systems need; 8) driveways for residential and light commercial use; and 9) bike paths, walkways, patios, and swimming pool aprons.

Portable Sediment Trap (895)

A compartmented container through which sediment-laden water is pumped to trap and retain the sediment. The purpose of this practice is to trap and retain sediment prior to pumping the water to drainage-ways, adjoining properties, and right-of-ways below the sediment tank site. A sediment tank is to be used on sites where excavations are deep and space is limited, such as urban construction, where direct discharge of sediment-laden water to stream and storm drainage systems is to be avoided. It is also used where an excavation extends below the seasonal water table causing a sump pump to be used.

Preservation of Natural Vegetation

Preservation of natural vegetation (existing trees, vines, brush, and grass) provides natural buffer zones. By preserving stabilized areas it minimizes erosion potential, protects water quality, enhances aesthetics, and provides wildlife benefits. This practice is used as a permanent control measure. This technique is applicable to all sites but is especially applicable to areas such as floodplains, wetlands, streambanks, steep slopes, sinkholes, and other areas where erosion control would be difficult to re-vegetate, install, or maintain the vegetation. Preservation of the vegetation should be planned before any site disturbance begins, preferably before site plan approval has been received from local

zoning and planning agencies. Good site management minimizes the impact from construction activities by clearly marking the boundaries for trees and other vegetation to be protected including the root structure. Maintenance is critical to the survival of healthy vegetation and provides effective water quality benefits. Maintenance requires regularly scheduled inspections and execution of maintenance items such as fertilizing, mowing, pruning, weed and pest control. Local and state regulations may require more stringent site specific management plans which must be adhered to.
[*Riparian Forest Buffer (391); Wildlife Upland Habitat Management (645); Wildlife Wetland Habitat Management (644)*]

Retaining Walls*

A constructed wall used to eliminate steep slopes between areas that have abrupt changes in grade. This practice is used to replace cut or fill slopes in confined areas or where a wall is necessary to stabilize slopes. Retaining walls can be constructed of reinforced concrete, treated timber, gabions, reinforced earth (system of face panels and buried reinforcement strips), or other manufactured products such as inter-locking concrete blocks. Each site is unique and requires detailed site plans for drainage, anchors, foundation, and backfill requirements.

Right-of-way Diversion (Water Bars) (900)*

A temporary or permanent ridge or ridge and channel constructed diagonally across a sloping road or utility right-of-way that is subject to erosion. It is designed to shorten the flow length within the sloping area. The purpose of this practice is to limit the accumulation of erosive volumes of water by diverting surface runoff at pre-designed intervals to a stable outlet. This practice applies where runoff protection is needed to prevent erosion on sloping access right-of-ways or other long, narrow sloping areas, generally less than 100 feet in width with a slope of 2% or less for an outlet. It generally is constructed of compacted soil or aggregate or a combination. Spacings are based on slope of right-of-way and range from 25-125 feet between the constructed ridges. Depending upon usage, these diversions require regular inspections and maintenance.

Riprap Lined Channel*

Waterways with an erosion-resistant rock lining designed to carry concentrated runoff to a stable outlet. This practice applies where conditions are expected to be unstable for use of grass-lined channels, such as 1) channels with average grades greater than 5%; 2) where continuous or prolonged flows occur; 3) potential for damage from traffic exists; 4) soils are erodible; 5) soil properties are not suitable for sustained vegetative growth; 6) design velocities exceed 5 feet per second; 7) channel location warrants the use of increased protection; and 8) channel will have prolonged periods of wetness which will hinder adequate growth of permanent grass vegetative cover.
[*Grassed Waterway (412); Lined Waterway/outlet (468)*]

Rock Dam*

A stone embankment with woven geotextile fabric designed to capture sediment on the construction site and prevent off-site sedimentation into streams, lakes, wetlands, and drainageways. This practice can be used as an alternative to a standard sediment basin for locations with a drainage area of 5 acres or less. It may be preferable to standard sediment basins for sites where an earthen embankment would be difficult to construct. [Maximum height of constructed embankment is 8 feet with a maximum life-span of 3 years or less.] A zero grade riprap apron for outlet protection may be required to provide outlet stability. Maintenance is required after a significant storm event.

Rock Outlet Protection (910)*

A section of rock protection placed as a zero grade (level) rock apron at the outlet end of culverts, conduits, or channels (interceptor dikes, swales, diversions, terraces, etc.). The purpose of this practice is to prevent scour erosion at stormwater outlets; to protect the outlet structure; and to minimize the potential for downstream erosion by reducing the discharge velocity and energy of concentrated stormwater flows that exceed the permissible discharge velocities of the receiving area. The outlet protection may require the use of a plunge pool to dispel more energy with greater efficiency by using it in combination with the apron. The practice also reduces the effects of turbidity and sedimentation. This is applicable where the discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the receiving drainageway. This could be 1) culvert outlets of all types; 2) pipe conduits from, dry or wet, sediment basins and stormwater detention basins; 3) new channels constructed as outlets for culverts and conduits; and 4) outflows from conduits or channels that do not exceed 12 feet per second. [Does not apply to continuous rock linings of channels, streams or slopes steeper than 10 percent where reconcentration of flows is encountered.] This type of protection can be achieved using riprap, concrete aprons, paved sections, and settling basins installed below the storm drain outlet.
[*Lined Waterway/outlet (468)*]

Sediment Basin, Permanent (960)*

A constructed barrier or dam with a controlled stormwater release structure formed by constructing an embankment of compacted earth fill across a drainageway. This practice applies where erosion control measures are insufficient to prevent off-site sedimentation. The purpose of a sediment basin is to detain sediment-laden runoff from disturbed areas in wet or dry storage long enough for most of the sediment to settle out. This practice applies at 1) outlets of diversions, channels, slope drains, or other runoff conveyances that discharge sediment-laden water; 2) below drainage areas that are 20 acres or less and does not exceed a maximum dam height of 10 feet; 3) where access can be maintained for sediment removal and proper disposal; 4) in the approach to a storm water inlet located below a disturbed area as part of an inlet protection system; 5) outlet from basin has a stable outlet using a zero grade riprap apron; 6) maximum structure life-span is 10 years with a drainage area of 20 acres or less with a minimum of 24 hour detention time and 7) where failure of the structure will not result in loss of life, damage to homes, commercial or industrial buildings, main highways or railroads, or in the use or service of public utilities. Structure must meet all local, state and federal dam safety requirements plus

safety concerns such as fencing. A sediment basin when used in combination with other control measures is quite effective in sediment removal.
[*Sediment Basin (350); Water and Sediment Basin (638)*]

Sediment Basin, Temporary (960)

A small, temporary ponding basin formed by construction of an embankment or excavated basin to capture sediment. The purpose of this practice is to detain sediment-laden runoff from disturbed areas for a sufficient period of time to allow the majority of sediment and other water-based debris to settle out so as to protect streams, lakes, wetlands, drainage systems, and adjacent property during construction activities. This practice applies at 1) outlets of diversions, channel, slope drains, or other runoff conveyances that discharge sediment-laden water; 2) below drainage areas that are 5-20 acres and does not exceed a maximum dam height of 10 feet; 3) where access can be maintained for sediment removal and proper disposal; 4) in the approach to a storm water inlet located below a disturbed area as part of an inlet protection system; 5) structure life of less than 18 months; 6) outlet from basin has a stable outlet using a zero grade riprap apron; and 7) where failure of the structure will not result in loss of life, damage to homes, commercial or industrial buildings, main highways or railroads, or in the use or service of public utilities. [This is not intended to be a permanent structure.] Structure must meet all local, state and federal dam safety requirements plus safety concerns such as fencing. A sediment basin when used in combination with other control measures is quite effective in sediment removal. A well designed and construct temporary basin that is designed to handle post-construction runoff volume may be converted to a permanent stormwater management structure.
[*Sediment Basin (350); Water and Sediment Basin (638)*]

Sediment Trap, Temporary (960)*

A temporary ponding basin formed behind an embankment or excavation to capture sediment. The purpose of a temporary sediment trap is to hold sediment-laden runoff, trapping the sediment. This practice protects receiving streams, wetlands, lakes, drainage systems, and adjacent property during construction activities. Temporary sediment traps apply wherever sediment-laden runoff is discharged, such as outlets of diversions, channels, stormwater conduits and slope drains, that have a stable outlet using a zero grade riprap apron. Maximum drainage area is 5 acres or less. [This is not intended to be a permanent structure (maximum life-span of 2 years and not greater than 5 feet of embankment fill.] Traps should be regularly inspected and sediment removed when 50% of the sediment storage capacity has been reached to maintain the life of the structure and meet the discharge restraints in the permit.
[*Sediment Basin (350); Water and Sediment Basin (638)*]

Seeding, Permanent (880)*

Establishing permanent vegetative cover on un-stabilized areas and these areas will remain unprotected for 12 months or more. The purpose of this practice is to provide economical long-term reduced erosion control and decrease sediment movement from disturbed areas, and to permanently stabilize such areas in a manner that adapts to site conditions and allows selection of the most appropriate materials. It applies to disturbed

areas where long-lived vegetative cover is needed to stabilize soil and on other areas where cover is desired. This is especially important where soils are unstable due to soil texture, structure, slope steepness, or depth of soils is limiting. Plant materials are selected based on climate, topography, soils, slope, aspect, potential land use, available light, aesthetics, and maintenance. It is a very necessary component to protect constructed earthen structures such as dikes, diversions, channels and embankments, waterways, earthen dams, filter strips, steep slopes, streambanks, and road banks to prevent erosion. Particular care is required to establish a high quality permanent vegetative cover that is enduring and thick. To ensure a quality stand, take a soil test, then apply and incorporate only those soil amendments determined by the test for the plants need.
[*Critical Area Seeding (342); Mulching (484)*]

Seeding, Temporary (965)

It is the establishment of a fast-growing, short-term (annual) vegetation to provide economical erosion control for up to 12 months and reduce the amount of sediment and other potential pollutants from moving off-site. Annual plants (annual grasses and cereal grains) which sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover and erosion control on disturbed areas. The purpose of this practice is to temporarily stabilize denuded areas that will not be brought to final grade or when construction will be stopped for a period of greater than 14 days. Temporary seeding helps reduce runoff and erosion until permanent vegetation or other erosion control measures can be established. In addition, it provides residue for soil protection during seedbed preparation and reduces problems of mud and dust production from bare soil surfaces during construction. This is applicable to all cleared, unvegetated, or sparsely vegetated soil surfaces where vegetative cover is needed for 1 year or less. If further delays occur due to weather, reseed again after 12 months to ensure adequate protection of the disturbed areas. This applies to earthen structures such as dikes, diversions, dams, temporary sediment basins, temporary road banks, topsoil stockpiles, and any other exposed areas of a construction area or site. It applies where short-lived vegetation can be established before final grading or in a season not suited to permanent seeding. It helps prevent costly maintenance operations of other erosion control systems such as a sediment basin clean-out. To ensure a quality stand, take a soil test, then apply and incorporate only those soil amendments determined by the test for the plants need.
[*Cover and Green Manure Crop (340); Mulching (484); Critical Area Seeding (342)*]

Silt Curtain, Flotation

A flotation silt curtain is a silt barrier used within a lake, pond, reservoir, or wetland. The flotation silt curtain consists of a filter fabric curtain weighted at the bottom and attached to a flotation device at the top. This structure is used to isolate an active construction area within a body of water to prevent silt-laden runoff water from migrating away from the construction zone and damaging environmentally sensitive areas. This is very effective for limiting the migration of suspended sediment within the body of water but it will not reduce the amount of disturbance from work performed within the water except to minimize the area effect. These curtains are attached to a floating tube on the water

surface with cables anchored into stable shoreline. This device should be maintained until such time when the disturbed area is stabilized and turbidity in the water has reached acceptable water quality standards. Prior to any design or proposed work that may exceed limits within the water body be sure to obtain all required permits from local, state or federal regulatory agencies.

Silt Fence (920)

A temporary barrier of entrenched woven geotextile fabric (filter fabric) stretched across and attached to supporting posts used to intercept sediment-laden runoff from small drainage areas (maximum of 1/4 acre per row of silt fence) of disturbed soil. The purpose of this practice is to cause deposition of transported sediment load from sheet flows leaving small disturbed areas. Silt fences may also prevent sheet erosion by decreasing runoff velocities. A silt fence is subject to limitations based upon maximum slopes, slope lengths, drainage areas, erosion from sheet erosion only. It should not be used for concentrated runoff flowing towards the barrier. To maximize efficiency, install the silt fence on the contour, not across gullies or concentrated flows. Use is applicable when the disturbed area remains exposed for 6 months or less but not exceeding one construction season. It may be used as a component for storm drain inlet protection. Silt fences need weekly inspections and maintenance after each stormwater runoff event. The life expectancy of a silt fence is most dependent upon the type of material used.

Slope Drain, Temporary (970)

A flexible tubing or rigid conduit extending temporarily from the top to the bottom of a cut or fill slope face. The purpose is to convey concentrated runoff down the face of a cut or fill slope without causing erosion on or below the slope. This practice applies to construction areas where stormwater runoff above a cut or fill slope will cause erosion if allowed to flow over the slope face. Temporary slope drains are generally used in conjunction with temporary diversions or diversion dikes to convey runoff down a slope to a stable outlet or a sediment basin. These should be used until such time when a permanent water disposal measure(s) can be installed, which may be converted to a permanent slope drain with a stable outlet (generally installed below the surface for future protection). Temporary pipes or conduits may be converted to paved chutes, metal, plastic, concrete, or clay conduits. The maximum drainage area should be 5 acres per drain. Any drainage area greater than one acre requires site specific design before installation. This practice is used in combination with level spreaders, diversion dikes or swales, or sediment traps.
[*Subsurface Drainage (606); Underground Outlet (620)*]

Sodding (925)*

Stabilizing final graded disturbance areas by laying a continuous cover of grass sod. The purpose is to prevent erosion and damage from sediment by stabilizing the soil surface and to improve the visual quality and utility of the area quickly. The practice is applicable where 1) the disturbed area requires immediate cover for erosion protection and sediment control such as slopes and filter strips; 2) where sodding is preferred to other means of grass establishment; 3) in residential or commercial areas where quick use or aesthetics are a factor; 4) places where surface water concentrates, such as, diversions,

swales or grassed-lined waterways carrying intermittent flows; 5) areas around drop inlets, stormwater detention basins, or in swales; and 6) any area where conditions make seeding impractical or impossible. Such examples of areas in need of quick establishment using sod are buffer zones, streambanks, road ditch banks, waterways, diversions, inlets to drainage systems, dikes, swales, steep slopes, filter strips, or level spreaders. Soil test the site then apply and incorporate the necessary soil amendments to ensure adequate nutrients to re-establish the sod for sustained growth. This method of establishing permanent cover can be used any time of the year except when the soil is frozen. Where concentrated water flows will flow over the sod, use one of several staking methods to hold sod in place until established.
[*Critical Area Seeding (342)*]

Soil Bioengineering for Slope Protection*
The use of live, woody vegetative cuttings to increase slope stability and repair slope failures such as shallow sloughs or slides. When the vegetative cuttings are placed in the ground, roots develop and foliage sprouts. These live woody cuttings can be live stakes, live fascines, brush-layers, or branch-packing. Soil bioengineering has the benefits of temporary and permanent vegetation to reduce erosion; off-site sedimentation; runoff; velocities; increased consumption of internal soil moisture; and increased infiltration. As the woody vegetation grows roots mechanically reinforce the soil providing greater protection than grass or a mechanical measure alone. Two approaches can be used 1) woody vegetation systems and 2) woody vegetation systems combined with simple inert structures. The structural portion allows for establishment on steep slopes or areas subject to extreme erosion from off-site to be protected. Both systems are effective and must be designed for site specific conditions. These systems grow stronger with time increasing the root holding power as trees and shrubs mature. The greatest advantage of this system is that this method can be applied to small sites where access by equipment is limited and limited access by animals can be achieved; to environmentally sensitive areas; and where minimal site disturbance is needed to establish. It is particularly suited for small, highly sensitive or steep slopes. Most techniques can also be used for stream channel or bank protection, and once it establishes (matures), most woody vegetation becomes self-repairing and needs little maintenance. Live woody cuttings in combination with porous, inert structural materials help create live crib walls, vegetative rock gabions, or joint plantings that stabilize slopes and improve erosion control.
[*Stream Channel Stabilization (584); Streambank And Shoreline Protection (580)*]

Stabilized Construction Entrance/exit Pad (930)*
A stabilized pad of stone base aggregate underlain with woven filter fabric located where construction vehicles can drop their mud to avoid transporting it directly onto a public right-of-way, road, street, alley, sidewalk, parking area, or other paved area. The purpose of this standard is to reduce or eliminate the tracking of sediment onto public right-of-ways or streets. This may be used in combination with other practice measures to accomplish the specific site or area needs. A stabilized construction entrance shall be used at all points of construction ingress or egress. This should not be used as an equipment washing site unless special provisions have been made for the collection of

wash-water. A permit may be required if such wash water is not properly collected and treated by a public water treatment system facility.
[*Access Road (560)*]

Stormwater Wetland, Urban (800)

A constructed system of shallow pools, wet ponds, and retention/detention ponds that create growing conditions suitable for emergent and riparian wetland plants, explicitly designed to lessen the impacts from stormwater quality and quantity in urban areas. Stormwater wetlands are designed and installed to maximize pollutant removal (sediment, trace metals, nutrients, hydrocarbons, harmful pathogens, and other oxygen demanding substances). Stormwater wetlands create wetland habitat through the creation of a matrix of water, sediment, nutrients, plants, and detritus that collectively provides temporary (detention time of 72 hours) storage of urban stormwater runoff. The wetland is designed to remove multiple pollutants from source water through a series of complementary physical, chemical, and biological pathways. This practice applies to urban or urbanizing watersheds where stormwater quality and quantity control is needed to meet the diverse management objectives of developers and local governing units. Wetlands can be typically constructed as an embankment across a valley, by constructing a perimeter berm, or by excavating a shallow basin in natural soil as a specific component of several urban multi-purpose stormwater management structures. Stormwater wetlands require from 6-10 acres of drainage for each acre of wetland created and require soils of low to moderate permeability (hydrologic soil groups C and D). Stormwater wetlands also require additional design storage for sediment at the wetland entrance should account for 20-40 years of sediment accumulation from the wetland drainage area. Stormwater wetlands require more management during the first three years to establish wetland conditions. Thereafter, maintenance requirements are similar to wet ponds. Stormwater wetlands typically are not located within delineated natural wetland areas. Natural wetlands provide critical habitat and ecosystem benefits and are protected under local, state, and federal statutes. Natural wetlands also can be ecologically damaged due to the increased sediment delivered. Stormwater wetlands differ from artificial or created wetlands because they lack the ecological functions of natural wetlands. Stormwater wetlands should not be confused with created or restored wetlands that are used to mitigate the loss of natural wetlands under permitting provisions of wetland protection. Wetlands (natural or constructed) require large acreage to be effective for water quality benefits.
[*Grade Stabilization Structure (410); Ponds (378); Structure for Water Control (578)*]

Straw Bale Barrier (935)

A temporary barrier consisting of a row or more of entrenched and anchored straw bales on the contour or similar material may be used to intercept sediment-laden runoff from small disturbed drainage areas. The purpose is to cause deposition of transported sediment from sheet flow leaving disturbed areas. Conditions for use are dependent upon maximum slope, slope length, and a drainage area (not greater than 1/4 acre). Sediment must be from sheet and rill erosion only, with no concentration of water flowing to the barrier, and the life span is 3 months or less until vegetative establishment. Straw bale barriers may be used across minor swales in watersheds, 2 acres or less of drainage area,

when the expected sediment-laden runoff is minimal, the topography is 2% or less slope and the slope length is 100 feet or less. It does not apply where soil is not sufficient to fully anchor the straw bales (rock or other hard surface).

Stream Crossing, Temporary (975)*

A bridge, ford, or temporary structure installed across a stream or watercourse for short-term use by construction vehicles or heavy equipment. The purpose of this practice is to provide a means for construction vehicles to cross streams or watercourses without moving sediment into streams, damaging the streambed or channel, or causing upstream flooding. This applies where heavy equipment must be moved from one side of a stream channel to another, or where light-duty construction vehicles must cross the stream channel frequently for a short period of time. Generally, a temporary stream crossing is applicable to flowing streams with a drainage area of less than 1 square mile. For larger drainage areas, a more exacting design is required. Temporary stream crossings can be designed as low water crossings, as an embankment with a culvert, or as a bridge with or without embankment approaches. Properly constructed crossings prevent turbidity and streambed disturbances. All stream crossings require the design assistance of a professional design engineer. All appropriate permits must be obtained from local, state and federal jurisdictions prior to installation of in-stream structures.

Streambank Setback*

The practice of limiting vegetation removal and grading of the riparian area along flowing waters. This practice is intended to protect the banks of natural streams from damage due to development, lessen the risk of flooding in developed areas and provide a buffer between the developed area and the stream. A properly maintained streambank setback will help maintain channel capacity and stability, reduce the sediment load in the channel and reduce the movement of potential contaminants into the stream. Setbacks help preserve natural channel meander and protect homes and other buildings from damage due to bank erosion. Streambank setbacks can also apply to areas adjacent to excavated open channels used for site drainage, drainageways, and watercourses that route stormwater runoff to streams. Prior to establishment of setback consult with the Federal Emergency Management Agency (FEMA) and other local and state agencies having regulatory control of floodplain management to determine the 100-year floodplains. A minimum distance of 50 feet from the streambank top. Where channel down cutting is occurring, a greater setback distances (100 feet if space exists) may be needed or is required. Maintenance of the streambank setback is an ongoing effort that requires inspections after major storm events to maintain quality cover while removing log jams that will damage streambanks or cause flooding.
[*Riparian Forest Buffer (391); Wildlife Upland Habitat Management (645); Wildlife Wetland Habitat Management (644)*]

Streambank Stabilization (940)

Stabilization of eroding streambanks by use of designed vegetative, structural, or a combination of both methods. The purpose is to protect streambanks from the erosive forces of flowing water. It is often necessary in areas where development has occurred upstream and full channel flow occurs several times each year. This practice is

applicable to sections of streambanks that are subject to erosion due to excessive runoff from pre-development and/or proposed construction activities. Generally it is applicable where flow velocities exceed 5 feet per second or where vegetative streambank protection is inappropriate. Vegetative protection is the least costly and the most compatible with natural stream characteristics, but is not effective where stream hydrology shifts are occurring. Since each reach of channel requiring protection is unique, measures for structural streambank protection should be evaluated and installed according to a plan based on the specific site conditions and designed by a professional engineer. Considerations in determining which type of streambank protection to use include: 1) current and future watershed conditions; 2) sediment load; 3) channel slope: 4) control of bottom scour; 5) soil conditions; 6) present and anticipated channel roughness; 7) compatibility with other improvements; 8) changes in channel alignment; 9) fish and wildlife habitat; and 10) future maintenance obligations. Measures that can be used singularly or in combination are 1) vegetative protection (grass, shrubs, trees, and aquatic plants) and 2) structural protection (riprap, rock armor, gabions, fabric formed revetments, log cribbing, reinforced concrete, grid pavers, cellular confinement matrices). All appropriate permits must be obtained from local, state and federal jurisdictions prior to installation for in-stream modifications.
[*Stream Channel Stabilization (584); Streambank And Shoreline Protection (580)*]

Subsurface Drain (945)

A conduit, such as corrugated plastic tubing, tile, perforated pipe, or continuous layer of porous material installed below the ground surface that intercepts, collects and/or conveys excess drainage water to a stable outlet. [***Subsurface drains by themselves provide no water quality benefits.***] This practice applies where ground water is at or near the soil surface and adequate surface drainage cannot be provided via safe surface runoff. There are two types of subsurface drains, relief drains and interceptor. Relief drains dewater an area where the water table is high. Interceptor drains are used to remove water where sloping soils are excessively wet and/or subject to soil slippage caused by hillside seeps. The purpose is to 1) improve the soil environment for vegetative growth and promote soil stability, thus reducing erosion and improving water quality; 2) collect ground water for beneficial uses, 3) remove water from heavy use areas, such as around buildings, roads, play areas, and accomplish other physical improvement related to water removal, and 4) regulate water to control health hazards caused by pests such as liver fluke, flies, or mosquitoes. Indirect water quality benefits include 1) regulating the water table and ground water flows, 2) intercepting and preventing water movement into a wet area, 3) relieving artesian pressures, 4) removing surface runoff, and 5) leaching of saline and sodic soils. This practice applies to areas having a high water table where the benefits of lowering the water table or controlling ground water or surface runoff justifies installation and associated costs. The soil should have adequate depth and permeability to be effective when installed The site should have a suitable outlet for the quantity and quality of effluent discharged from the drain.
[*Subsurface Drainage (606)*]

Sump Pit (950)

A temporary pit which is constructed to trap and filter water for pumping into a suitable discharge area. The purpose of this practice is to remove excessive water from excavations in a manner that improves the quality of water being pumped. Sump pits are constructed when water collects during the excavation phase of construction, especially excavation of building foundations.

Surface Roughening

Surface roughening is a temporary erosion control practice. The soil surface is roughened by the creation of horizontal grooves, depressions, or steps that run parallel to the contour of the land. Slopes that are not fine-graded and that are left in a roughened condition can also control erosion. Surface roughening reduces the speed of runoff, increases infiltration, and traps sediment. Surface roughening also helps establish vegetative cover by reducing runoff velocity and giving seed an opportunity to take root and grow. It is appropriate for all slopes. This should be done as soon as possible after the original vegetation has been removed from the slope. It should be used immediately after final grading activities have ceased. This can be applied using stair-step grading, grooving (disks, spring harrows, or teeth on a front-end loader), and tracking (driving a crawler tractor up and down the slope, leaving cleat imprints parallel to the slope contour). This practice applies to slopes flatter than 2:1.
[*Surface Roughening (609)*]

Swale, Temporary (980)*

A linear depression in the ground surface which carries drainage runoff but does not block traffic as do ditches, gutters, or diversions. This practice applies anywhere a drainage conveyance is required and can be used as an alternative to closed pipe systems. Grassing the swales also provide the benefits of reducing storm water velocity, promoting infiltration and removing sediment. The design drainage area should be less than 3 acres and a graded channel that will not erode when the soil is bare.
[*Surface Drainage, Field Ditch (607); Lined Waterway/outlet (468)*]

Top Soiling (981)

Preserving topsoil prior to construction and using it after construction to aid in vegetation establishment on the construction site. Methods of preserving and using topsoil to enhance the final site stabilization with vegetation. The purpose of this practice is to provide a suitable growth medium for final site stabilization with vegetation. This practice applies where 1) the preservation or importation of topsoil is determined to be the most effective method of providing a suitable growth medium; 2) where the subsoil or existing soil present any or all of the following problems; a) physical and chemical properties such as texture, bulk density, pH, or nutrient balance of soil cannot be modified; b) the soil is too shallow to provide adequate rooting depth or cannot supply ample moisture or nutrients for desired vegetative growth; and c) the soil contains toxic or potentially toxic substances; and 3) where high-quality turf or ornamental plants are desired. This practice applies to areas on a site that will be disturbed by excavation, compaction or filling, and to areas where the subsoil is unsuitable for plant growth. A minimum of 24 inches of combined topsoil and subsoil is needed for adequate vegetative

growth. A soil test should be taken and necessary soil amendments added and incorporated to correct soil deficiencies. Soil test the topsoil then apply and incorporate necessary soil amendments to ensure adequacy to establish and sustain vegetative growth or other intended uses.
[*Critical Area Seeding (342); Spoilbank Spreading (572)*]

Tree and Shrub Planting (985)

Planting selected trees and shrubs in the soil. The purpose of this practice is to establish trees and shrubs to conserve soil, beautify an area, screen unsightly views, provide shade, conserve energy, and attract wildlife. This practice applies in urban environments where woody tree and shrub species are needed to protect the soil from erosion, where ornamental plants are desirable for landscaping and beautification and where woody plants are needed to screen unsightly views, reduce noise levels, conserve energy, or provide wildlife food and habitat. When planting woody plants species, consideration should be given to utilities above and the below ground surface for safety and health reasons.
[*Tree Planting (612); Hedgerow Planting (422)*]

Tree and Shrub Protection (990)*

Preserve and protect trees during development for their aesthetic and economic value, and their aid in energy conservation, landscaping, air purification, bank or slope stabilization, and erosion control.   The purpose is to preserve and protect desirable trees and shrubs that have present and/or future value for erosion protection, for landscape and aesthetic value, or for other environmental benefits. This practice applies on all development sites containing stands of desirable trees and shrubs. Trees and shrubs can be damaged or killed by direct contact with construction equipment, compaction of the soil within the root zone of the tree or shrub, filling of subsoil or topsoil around tree bases to cause suffocation of roots and the plant, changes in elevation of the water table due to site grading, and from construction chemicals and refuse. Although damage may be unseen, it can result in the eventual death of the tree within 3-4 years. Root zone damage is the leading factor of unintentional death. A thumb rule for protection of the critical root zone would be to keep all activities (excavating, traffic, or storage sites) outside of the tree canopy drip-line.
[Forest Stand Improvement (666); Tree Planting (612); Hedgerow Planting (422)]

Vegetative Streambank Stabilization (995)

The stabilization and protection of eroding streambanks with selected vegetation. The purpose is to protect streambanks from the erosive forces of flowing water and provide a natural, pleasing appearance. This applies to natural or excavated channels where the streambanks are susceptible to erosion from the action of flowing water, ice or debris and the problem can be solved using vegetative measures. Vegetative stabilization is generally applicable where bankfull flow local velocity does not exceed 5 feet per second and the soils are erosion resistant. Any soils not erosion resistant and where local velocities exceed 5 feet per second at bankfull need structural measures. All necessary permits must be obtained from local, state, or federal jurisdictions prior to installation.
[*Stream Channel Stabilization (584); Streambank And Shoreline Protection (580)*]

OTHER MEASURES

Forested Riparian Buffer

[*Riparian Forested Buffer (391)*]

IN-STREAM MEASURES

Eddy Rocks
Deflectors (Jetties)
Gravel Riffles (New Channel Stabilization)
Multi-stage Channel (Low Flow Augmentation)
Vortex Rock Weir (Grade Stabilization)

GOOD HOUSEKEEPING PRACTICES

Good housekeeping is basically keeping a clean, orderly construction and industrial site. One of the first steps towards preventing stormwater contamination is improving house keeping practices listed below and using good common sense. Good housekeeping practices reduce the possibility of accidental spills, improve the response time if there is a spill, reduce safety hazards as well, and improve the overall appearance of the construction site.

Accidental Spills

Spills are a source of stormwater contamination within construction sites. Spills contain soil, water, and waste materials that can produce potential health risks to the environment. Spills should be dealt with quickly and effectively to reduce the overall impact on water quality and the environment. Construction precautions should develop a spill plan to stop the source of the spill, contain the spill, clean up the spill, dispose of the contaminated materials, and identifies capable individuals and agencies to minimize the impact from a spill. Store and handle materials to prevent spills and reduce the potential for stormwater contact. Allow only authorized personnel to obtain, handle, and secure materials that can pose a problem.

Concrete Trucks

Most construction projects include some sort of concrete work. Usually, concrete is premixed offsite and delivered. The concrete is poured and residual amounts of concrete mix remain in the truck, or occasionally, excess concrete is delivered, or the concrete is rejected and thus dumped. Emptying or wash out of excess concrete may be allowed onsite. However, it should be disposed of in a manner that prevents contact with stormwater runoff discharged from the site into a stream. Dikes or sumps could be constructed to contain these concrete materials until it solidifies and then can be properly handled and disposed. Concrete mixes contain various substances which should not be allowed to contaminate runoff water.

Contaminated Soils

Contaminated soils are soils which have been exposed and still contain hazardous substances. Contaminated soil may be encountered onsite during earthmoving activities or during the cleanup of a leak or spill of hazardous product. Material storage areas may also have been contaminated by undetected spills where the nature of the contaminants may or may not be known. Contact the local or state regulatory agency for the proper protection, treatment, or disposal of these contaminated soils.

Control of Allowable Non-storm Water Discharges

Most stormwater permits do not include the discharge of non-storm water discharges. The following list of non-stormwater discharges are typically allowed: 1) discharges from fire fighting activities (where previous discussed contaminants have not been used, stored, or spilled); 2) fire hydrant flushing; 3) potable water line flushing; 4) uncontaminated ground water (dewater); 5) foundation or footer drain not contaminated with process materials such as solvents; 6) springs, riparian habitats, and wetlands; 7) irrigation water; 8) exterior building wash down (if only water is used - no cleaning solutions); 9) pavement wash waters; and 10) air conditioning condensate.

Construction Wastes

Construction wastes are numerous depending upon the site. Construction materials include packaging materials (wood, paper, plastics, etc.), trees and shrubs from clearing and grubbing the site, scrap or surplus building materials (scrap metals, rubber, plastic, masonry products, glass, and other solid waste materials), paints and paint thinners, and rubble (materials resulting from demolition). Those materials (non-native) which are easily removed should be properly disposed in approved landfills and/or recycled. Other permissible materials may be properly disposed on site provided it does not impede the flow or pollute public waters, fill stormwater retention areas (wetlands or depressions), or impair visual appearances on the landscape.

Dewatering

Dewatering is the method used to remove and discharge excess water from a construction site. Most commonly this is accomplished using a pump where natural gravity does not occur. Otherwise it occurs through normal drain off into sediment traps, sediment basins or graded outlet (excavated areas). The most common application is to lower a high water table which will stabilize the construction site and permanent facilities being installed. Dewatering may be used during construction to remove accumulated water and sediments from sediment traps and basins as part of a maintenance schedule. Filtering should be provided when discharging from such facilities since the water generally contains high sediment content and other possible floating debris.

Fertilizers/Detergents

Nutrients such as phosphorous and nitrogen are found on construction sites in both fertilizers and detergents. Fertilizers are used to establish plant growth. However, excess fertilizers applied can be carried off in runoff waters as a contaminant. Fertilizer management involves control of the rate, timing, and method of application. Management plans should have the ultimate goal of retaining nitrogen and phosphorous

from entering surface water runoff and nitrogen from entering groundwater. Detergents can contribute to water pollution if wash waters are released into the environment and carried by surface water runoff to a body of water either through the stormwater drain system or directly into tributaries adjacent to the development site as surface water runoff . Caution should be exercised to not over apply nutrients when establishing vegetation, limit the total area disturbed at any one time, and make repeat applications of nutrients as the plant grows. Hydro-seeding with a tacking substance can reduce runoff contamination concerns. Avoid excessive use of fertilizers and detergents on the site. Detergent-contaminated wash water should be contained on site and hauled similarly as is domestic waste.

Hazardous Materials and Wastes

Many of the materials found on at a construction site may be hazardous to the environment or to personnel. It is important to read all labels of the materials or products you have on site; they may contain warning information that will help you to become aware of a potential problem. The following list of substances (at a minimum) should be considered hazardous: 1) paints; 2) acids for cleaning masonry surfaces; 3) cleaning solvents; 4) chemical additives used for soil stabilization (palliative such as calcium chloride); and 5) concrete curing compounds and additives. Follow the instructions provided on material safety data sheets (MSDS) for proper handling and disposal of wastes.

Litter Control

Litter control involves the removal of litter from streets and other surfaces before runoff or wind moves these materials to surface waters. This practice will prevent litter from becoming potential pollutants as well as improve the aesthetics of the area. A major source of phosphorous in urban runoff is from the leaves and lawn clippings. Removing these materials before they enter surface waters can reduce phosphorous loadings significantly. Other litter considered in this practice includes pet wastes, trash, oil, and chemicals (pesticides and cleaners). Besides the nutrients being contributed, most of the materials are organic and create a high oxygen demand when they break down in the water body. Pet wastes also pose a significant threat to water quality by contributing bacteria and other potential parasitic pathogens harmful to human and animal contacts. Phosphorous levels can be reduced by as much as 30-40% just by implementing litter controls. To be most effective this practice requires community-wide involvement. Programs provided on a community-wide basis could include some or all of the following: leaves and grass clipping recycling; street cleaning on a regular basis; catch basin cleaning; garbage collection; and imposing pet waste management strategies. Most of these programs have an educational component attached to sensitize the public as a whole.

Natural Geologic Drainage

Natural geologic drainage can contain acid and alkaline solutions from exposed soil or rock formations high in acid or alkaline substances formed in the natural elements. Control of these potential pollutants involves good site planning and pre-construction geologic investigations. Plans to seal fractures in bedrock with grout and bentonite will

often reduce the amount of seepage. If the source of clean water entering the fractures can be determined and this water can be diverted, this may be the best practice available. Another method is to neutralize the seeping solution(s) before it leaves the site.

Pesticides

Pesticides include insecticides, rodenticides, fungicides, and herbicides which are often used on construction sites. Steps should be taken to reduce the risks of having to use pesticides, but when you must, handle the materials as infrequently as possible, observe labels for proper application rates, application methods, handling, storage, personnel safety, and disposing of unused portions and rinsed pesticide containers. Store pesticides in a locked, fire-proof, and dry area. Provide curbs or dikes to contain any accidental spill and have measures available to contain and cleanup spills

Petroleum Products

Oil, gasoline, lubricants, and asphaltic substances such as paving materials are considered petroleum products. These materials should be handled carefully to minimize their exposure to stormwater. Petroleum products usually occur where road construction is occurring, at vehicle storage areas, or areas where onsite fueling and equipment maintenance is performed. Contain and cleanup petroleum spills immediately. Prevention is the key to any spill or leak, therefore, prepare a containment area to capture leaks from storage containers. While refueling and changing lubricants, use a portable device or construction of a temporary earthen dike.

Sandblasting Grits

Sandblasting is a commonly used technique to remove paint, dirt, etc., from surfaces. Sand is sprayed on the surface to be cleaned. Sandblasting grits consist of both the spent sand and the particles of paint and dirt removed from the surface. Grits are considered a hazardous waste if they were used to remove paints from old structures where lead, cadmium, or chromium based paints were used. These materials should not be allowed to enter stormwater drains, sanitary sewers, or any other public water conveyance.

Sanitary/septic Disposal

Almost all construction sites have a sanitary facility for onsite personnel. The most common facility is a portable facility that stores human body wastes (domestic) and is periodically emptied by a permitted hauler and emptied at an approved sanitary sewage facility site. Domestic waste haulers will know when and where to haul and properly handle untreated (raw sewage) septage. Untreated sewage or septage should never be discharged or buried onsite.

Street Sweeping

Street sweeping involves the removal of grit, debris, and trash from urban impervious areas such as streets, parking lots, and sidewalks. This practice is applicable during the construction phase and upon completion of the development. Streets are normally swept with either a mechanical broom sweeper or a vacuum sweeper. If these materials are removed from the streets and gutters where they are deposited, they can not be swept into streams by stormwater runoff. In most cases this operation has been used for aesthetics,

however it has been shown that sediment, nutrient, and oxygen-demand substance loadings can be reduced significantly when surfaces are swept frequently. More modern efficient street sweepers, and more skillful equipment operators make this operation more appealing to achieving water quality benefits. Coarse pebbles, grit, leaves, trash, and other debris is most effective in the sweeping operation. Sweeping is most effective two times a year, early spring and late fall. During these times it is easier to capture de-icing chemicals and sanding grits applied during the winter season and leaves and other lawn clippings from the balance of the year.

Sump Pit

A sump pit is a temporary hole or pit placed so that it can collect water from sediment traps and basins or excavations. In the center of the pit is a standpipe with holes which is surrounded by stone. Water that collects in the pit flows through the gravel into the standpipe and is pumped out to a filtering device or, in some cases, directly to a receiving water. The sump pit discharge may be pumped directly to a receiving water only if the standpipe has been properly wrapped in filter fabric medium. The number and location of sump pits used in traps or basins will depend upon the specific site or any other state or local requirements.

Waste Disposal

Proper management and disposal of building materials and other construction site wastes is an important part of pollution prevention. Construction materials overlooked as potential sources of stormwater contamination include surplus or refuse building materials including hazardous wastes and materials. This practice does not provide specific details on how to handle or dispose of these materials. Consult the product label or supplier and your local, state and federal regulatory agencies for proper disposal procedures.

INSPECTIONS

Inspection is a process by which an evaluation of pollution prevention measures applied are still effective. In most cases, inspection of prevention measures requires an inspector to look at all disturbed areas and sediment control measures on site taking measurements of sediment accumulation (depending upon measures installed). Inspections are conducted on a regular schedule plus after every significant rainfall event causing surface water runoff. A regular inspection and maintenance program reduces the chance of contaminating stormwater by finding and correcting problems before the next runoff event. The inspector should determine whether or not the measure was installed or performed correctly; whether or not there has been damage to the measure since it was installed or performed; what should be done to correct any problems with the measures installed; and finally what measures will accomplish the same objectives for a failed prevention measure installed. The following areas are of importance when performing a site inspection: 1) seeded areas (permanent and temporary); 2) mulched areas; 3) areas stabilized with geotextiles; 4) sod stabilized areas; 5) silt fences and straw bale barriers; 6) earthen dikes; 7) brush barriers; 8) drainage swales (grassed waterways); 9) sediment traps and basins; 10) subsurface drains; 11) pipe slope drains; 12) level spreaders; 13) storm drain inlet protection measures; 14) rock dams and outlet protection; 15) reinforced

soil retaining systems; 16) diversion(s); 17) buffer zone(s); detention ponds and basins; 18) filter strips; 19) terraces; 20) impoundment structures; 21) infiltration devices; 22) bio-engineered slope protection; 23) stormwater wetlands; 24) streambank stabilization (vegetative and structural); 25) streambank setbacks; 26) vegetation preservation; 27) stream crossings; 28) tree and shrub plantings and protection; and 29) good housekeeping practices.

MAINTENANCE

Maintenance of pollution prevention measures involves the upkeep and repair of the installed measures to reduce stormwater contamination. Maintenance is important because the control measures implemented may be of little or no use if they have not been properly maintained or managed. Good maintenance helps to ensure that these measures are in proper working order when called upon during a runoff event or during a spill condition. Maintenance includes those procedures or techniques used to maintain good effective operating condition vegetation, erosion or sediment control measure, and other protective measures identified in the site plan. Maintenance should be performed either on a interval determined by the design professional or when the inspection report finds it necessary to be most effective. Most maintenance activities for erosion and sediment controls are fairly basic.

RECORDKEEPING

It is important to document the inspection and maintenance of the pollution prevention measures installed. These records can be used to request scheduling for maintenance and repair needed. It also can be used to prove to local and state agencies that the installed measures are adhering to the permit granted. Stormwater plan managers should request their consulting design professional develop and provide an inspection, maintenance, and recordkeeping process with record keeping forms to report observations and along with key features to monitor as requirements of the permit.

REFERENCES

Storm Water Management for Construction Activities-Developing Pollution Prevention Plans and Best Management Practices, USEPA Office of Water (WH-547), EPA 832-R-92-005, 9/92

Standards and Specifications, Section IV, Field Office Technical Guide (FOTG), USDA-NRCS-Missouri

Protecting Water Quality - A Field Guide to Erosion, Sediment, and Storm Water Best Management Practices for Development Sites in Missouri, St. Charles SWCD and DNR-DGLS, 11/95

Protecting Water Quality in Urban Areas-Best Management Practices in Minnesota, Minnesota Pollution Control Agency, Division of Water Quality, St. Paul, MN, 12/94

Illinois Urban Manual; A Technical Manual Designed for Urban Ecosystem Protection and Enhancements, Illinois Environmental Protection Agency, Prepared by USDA-Natural Resources Conservation Service, 1995

FOOTNOTES

* PRACTICE TERMINOLOGY USED IN MISSOURI SWCD PUBLICATIONS

"MULCHING (484)" - USDA-NRCS-MISSOURI CONSERVATION PRACTICE TITLES AND CODES

RESOURCE EXTRACTION

SURFACE AND SUBSURFACE MINING

The state has active and abandoned surface mines for a number of commodities. The most important mines in terms of amount of surface areas affected are coal, limestone and barite. Other common surface mining is for clay, sand and gravel.

The state has many flooded abandoned underground mines. These are predominantly coal mines (from north central to southwest Missouri) and lead-zinc mines (St. Francois, Madison and Jasper Counties). In the Joplin area, the shallow bedrock aquifer has elevated levels of sulfate and several heavy metals due to mineralization of groundwater in flooded mines.

Water Quality Problems

The latest state assessment indicates a total of 156 miles of stream are adversely affected by mining activities, of which 128 miles are affected by abandoned lead-zinc mined lands and 26 miles by drainage from abandoned coal mined lands. Abandoned lead-zinc mines and their tailings continue to impact waters decades after mining has ceased. Missouri's Superfund Program is addressing some of these concerns. However, long-term impacts are expected to remain.

Regulatory Controls

Discharges from all areas, point or nonpoint, are required to meet the state's water quality standards found at 10 CSR 20-7.031. Facilities that have National Pollutant Discharge Elimination System [NPDES] permits must comply with permit limits instead of water quality standards.

All areas having a discrete discharge are considered point sources and must also comply with the state permit regulation 10 CSR 20-6.010 and with the state effluent regulations 10 CSR 20-7.015, including appropriate federal effluent standards and guidelines 40 CFR subchapter N. effluent standards and guidelines. Many areas previously considered nonpoint sources are now considered point sources and are being permitted per state stormwater controls guidance contained in 10 CSR 20-6.200. This includes areas where stormwater runoff is collected by man-made or natural conveyances and discharged at discrete locations.

Due to loss of state funding in 2003, Missouri no longer regulates coal mining as previously required by Chapter 10 CSR 40. However, Federal regulations are in effect at 30 CFR to regulate active surface coal mining. Surface coal mines must also comply with the performance standards of 30 CFR 816 and requirements for the protection of the hydrologic balance are given at rule 30 CFR 780.21 and 816.41. In-situ coal processing (solution mining, borehole mining, fluid recovery mining, etc.) must meet the performance standards of rule 30 CFR 828, which includes provisions for monitoring surface water and groundwater. Stability and maintenance of tailings dams greater than 35 ft. in height is controlled by state regulations 10 CSR 22-1.010 through 4.020 and Missouri State Statute Chapters 236.400 through 236.500. (See Table 13.)

Table 16
REGULATORY AUTHORITY/RESOURCE EXTRACTION

Agency/ Program	Statute or Regulations	Activity	Funding
DNR/LRP-AML	30 CFR	Identify and rank abandoned mined lands. Contract for reclamation according to established priority.	100% federal (tonnage fee on surface mined coal)
DNR/LRP-IM	RSMo 444.500 RSMo 444.760	Issue permits for mining of limestone, sand, gravel, barite, tar sands and clay.	Permit fee
DNR/LRP-SC	30 CFR 710 - 882	Regulate surface mining. (All runoff from a permit area is point source discharge requiring NDPES permit.) Extensive permitting and control. Frequent inspections at least 1/mo.	100% federal
DNR/WPCP-PS	10 CSR 20-6. 10 CSR 20-7. 40 CFR subchapter N	Permit to discharge, develop limits for discharge, monitor discharge and water quality standards.	Federal
DNR/WPCP-PS	40 CFR 122 10 CSR 20-6.010	Regulate stormwater runoff and storm generated pollutants.	Federal
DNR/GSP-EG	RSMo 259 10 CSR 50	Regulate brine injection recovery mining.	Federal
DNR/DRSP	RSMo 236.400-.500 10 CSR 22-1.010-4.020	Regulate stability and maintenance of tailings dams greater than 35 ft. in height.	Federal
DNR/WPCP/ PLANNING	10 CSR 20-6.060	Water quality certification of dredge and fill activities to waters of the United States, including wetlands.	100% State
USCOE	33 CFR Pts. 320-330	Regulate discharge of dredge and fill activities to the waters of the United States, including wetlands.	100% Federal

KEY
USCOE = U.S. Army Corps of Engineers
DNR = Department of Natural Resources
LRP = Land Reclamation Program
WPCP = Water Pollution Control Program
GSP = Geological Survey Program
DRSP = Dam & Reservoir Safety Program
AML = Abandoned Mined Lands
IM = Industrial Minerals
SC = Surface Coal
PS = Permits Section
EG = Economic Geology

Control Programs and Concerns

Active waste disposal from underground metallic mineral mining is adequately regulated via NPDES permits, dam safety regulations and the Metallic Minerals Waste Management Act. The Act also provides regulatory controls on tailings piles once mining and milling cease at presently active mines.

Abandoned tailings ponds are huge concentrations of fine, easily eroded ground rock contained by earthen/ground rock dams. If the dam face and water control and internal drainage structures are not maintained, the dam can fail. Excessive amounts of sediment washed into receiving streams can bury the stream bottom, degrading aquatic habitat and introducing lead and other heavy metals into the aquatic ecosystem.

Ongoing and generally successful programs regulate active coal mines and reclaim some abandoned mine lands. Recent changes in the Abandoned Mine Land Program have allowed the environmental benefits of reclamation to be given greater consideration when prioritizing projects for future construction funding.

The greatest area of concern is for abandoned non-coal mining areas where reclamation costs are typically very high and funding for this kind of work is difficult to obtain.

Erosion and subsurface flow through of mine tailings adversely affect many streams in the state. Reclamation of these areas involve earth moving, regrading the site, re-vegetation of treated mine spoils, diversion of surface waters around the site, and various forms of discharge structures and water treatments. The expense would commonly exceed the resources of the present landowners and there are few sources of funding available for this kind of work.

Table 17
BEST MANAGEMENT PRACTICES
EROSION, DEPOSITION OF SEDIMENT IN STREAMBEDS AND DISCHARGE OF METALS INTO RECEIVING WATERS

PRACTICES	ADVANTAGES	DISADVANTAGES
<u>Reduce Erosion</u> Artificial windbreaks.	Low maintenance costs.	High initial cost.
Tree windbreaks.	Low cost.	May be difficult or impossible to establish in some locations.
Establish vegetative cover.	Effective in reducing wind and water velocities across tailings.	May be difficult and expensive to establish vegetation. Periodic maintenance activities may be necessary to keep vegetation alive. (Irrigation, mulching, fertilization, liming).
Promote increased use of tailings.	Reduces the size of tailings areas.	Some tailings areas are so large, this practice would be inconsequential. Lead-zinc tailings contain small amounts of lead, an environmental toxicant.
Eliminate or reduce human activities on tailings.	Preserves other BMPs.	Tailings are often popular recreation areas.
Divert surface runoff away from stockpiles.	Decreases volume of water in contact with stockpiles.	Initial cost to install diversion structure.
Collect and settle all runoff water from stockpiles.	Reduces amount of solids and turbidity in runoff water discharges from the site.	Space limitations may make this impractical in some locations.

Table 17 cont.
BEST MANAGEMENT PRACTICES
EROSION, DEPOSITION OF SEDIMENT IN STREAMBEDS AND DISCHARGE OF METALS INTO RECEIVING WATERS

PRACTICES	ADVANTAGES	DISADVANTAGES
<u>Prevent Dam Failure</u> Perform annual dam safety inspection	Evaluate stability of dam and make recommendations for any rehabilitation work needed. (Required for all dams over 35' in height.)	Additional work load for DNR staff.
Perform regular maintenance, particularly of overflow structures and internal drains	Prevents improper or excessive water movement over the dam, which can cause erosion of the dam. Maintenance costs are much less than repair costs.	Some additional maintenance costs.
<u>Road Construction</u> Use existing roads whenever possible when drilling test holes.	Minimizes disturbance of soil and vegetation caused by construction of temporary roads.	Aesthetically unappealing drill sites are more likely to be seen by the public.
<u>Smelter Areas</u> Pave all areas around smelters, collect and treat all waters from these areas.	Reduces infiltration of contaminated waters and reduces discharge of untreated runoff.	Additional cost of paving and increasing size of treatment facilities to handle stormwater runoff.
Properly operate and maintain baghouse dust collection system.	Decreases stack emissions of metal particulates (Pb emissions regulated by DNR Air Pollution Control Program).	Some additional operation and maintenance cost.
Spray paved areas regularly. Collect runoff.	Collection and treatment of fugitive dust.	Some additional operation and maintenance costs.
Separate precipitation from process water and contaminated water.	Minimizes commingled water that requires collection, storage and treatment. Use of gutters and enclosures at some of the buildings and reduced dumping of ore in outside areas have possible application.	Some additional operation and maintenance costs.

Table 18
BEST MANAGEMENT PRACTICES
FLOW OF MINERALIZED AND ACIDIFIED SURFACE AND GROUND WATER INTO RECEIVING WATERS

PRACTICES	ADVANTAGES	DISADVANTAGES
Reduce surface water inflows by use of diversion structures and by plugging bore holes and mine shafts.	Reduces volume of water mineralized in the mines.	High costs of locating the many openings, especially in the tri-state area, and high construction costs for plugging openings and diverting flows. It is not known how important these sources are as recharge points for shallow ground waters.
Locate drinking water wells away from mines. (DNR-DGLS can provide technical assistance.)	Less mineralized drinking water.	Costs for new wells and piping from new well(s) to distribution system.
Treat major artesian flows.	Would reduce levels of metals in discharge.	High initial costs. High operational costs. Alleviates symptoms instead of source of the problem. Would treat only those flows that would be practical to collect.
Regrade to facilitate runoff and retard infiltration.	Reduces volume of water available for subsurface acidification.	May aggravate surface erosion problems. Initial costs can by high.
Surface apply agricultural lime on land to treat small acid seeps.	Neutralizes some subsurface acidity.	Generally none, but high applications may hurt soil fertility.
Collect and treat acid waters.	Initially much less costly than land reclamation.	Treats symptoms rather than cause of problem. Perpetual treatment becomes very expensive.
Deeply bury most mineralized fraction of spoil during active mining.	Reduces contact of mineralized spoil with infiltrating surface or shallow ground waters.	Cost of segregating spoils by quality may be high.

Table 18 cont.

BEST MANAGEMENT PRACTICES

FLOW OF MINERALIZED AND ACIDIFIED SURFACE AND GROUND WATER INTO RECEIVING WATERS

PRACTICES	ADVANTAGES	DISADVANTAGES
Compact surface soil.	Reduces infiltration of surface water.	May retard good vegetative cover thereby increasing erosion problems.
Tile or install other rapid subsurface drainage systems.	Intercepts infiltrating surface water and routes away from buried mineralized spoil.	High initial cost. May make site excessively dry and difficult to establish good vegetative cover.
Install artificial aquatards.	Intercepts and diverts laterally-moving ground waters away from buried spoil.	High initial cost.
Create marsh that puts an anaerobic layer between oxygen supply and acid materials. Plant cattails which reduce acidity.	Creates wildlife habitat, low initial cost.	

Table 19
BEST MANAGEMENT PRACTICES
IN-STREAM MINING ACTIVITIES

PRACTICES	ADVANTAGES	DISADVANTAGES
Restrict in-channel mining to exposed sand and gravel bars.	Reduces perturbation of aquatic benthos and turbidity.	Eliminates a portion of the total resource from use.
Create berms to divert flows away from active mining areas or pools created by mining.	Decreases turbidity and prevents excessive solar heating.	May not be practical for mining in small stream channels.

SAND AND GRAVEL MINING

Characterization

Sand and gravel mining is a common activity in Missouri's watersheds. The size of operations varies greatly from large-scale commercial sand and gravel removal to individuals removing gravel from their own land for their personal use. Estimating the extent and effect of sand and gravel mining in Missouri is difficult because of the variance in size of operations, the number of sand and gravel miners and mine sites, and the remoteness of many sites.

A common perception in Missouri is that gravel accumulates in Ozark streams, building up a supply that must be removed before it "chokes" the stream. This accumulation was thought to be due to post settlement land-use changes, including deforestation of the uplands from 1880 to 1920, open-range grazing, upland row-crop agriculture, riparian land-use changes, and seasonal burning. A recent research report by the U.S. Geological Society, "Erosion and Deposition at the Riffle-Pool Scale in Gravel-Bed Streams, Ozark Plateaus, Missouri and Arkansas, 1990-1995," has greatly elaborated upon the history and effects of land-use changes and determined that the issue is much more complex than previously thought. In fact, increased gravel loading is also due to increases in volume and velocity of water brought about by various land-use changes within the stream or watershed that de-stabilized stream banks. Studies also show that, within the last 70 years, some basins have experienced degradation, some experienced waves of accumulation and degradation, and some were stable. Sand and gravel mining can significantly degrade Missouri's water quality and aquatic habitat if not managed appropriately.

Federal and State Authorities

Several federal and state agencies are involved in water quality protection activities with respect to sand and gravel mining. To further complicate the matter, the court system has recently been called upon to review the regulatory authority of the U.S. Army Corps of Engineers over part of sand and gravel mine discharges. The result of this court review has significantly decreased federal regulatory control over many sand and gravel mining operations.

The U.S. Army Corps of Engineers regulates placing dredged or fill material in waters of the United States under Section 404 of the Clean Water Act and under Section 10 of the Rivers and Harbors Act of 1899. "Fill" is essentially any solid substance, such as gravel, dirt, or rock. Waters of the United States include essentially all lakes, rivers and streams, including intermittent or dry streambeds and wetlands. Sand and gravel operations within the Corps jurisdiction require what is referred to as a 404 permit to operate.

However, in June 1998, the Corps of Engineers lost a lawsuit levied by the American Mining Congress, which resulted in the nullification of the so-called Excavation or Tulloch Rule. Under the Excavation or Tulloch Rule, the incidental redeposit of materials as they were scooped from the streambed by sand and gravel mining equipment was regulated as a dredged and fill material. However, the court recently ruled that such a "redeposit" was not an added pollutant, and therefore this activity was no longer regulated under Section 404. Hence, sand and gravel mining activities are no longer regulated by the Corps of Engineers if they remove the material from "bucket to truck" and do not place or store any material between the ordinary high water marks of the stream.

If the Corps determines that a 404 permit is required for a sand and gravel mining operation, then Section 401 of the Clean Water Act requires that this permit be certified with management practices or be denied as appropriate to protect water quality. In Missouri, the Missouri Department of Natural Resources develops water quality based conditions as part of the 401 certification. These conditions become part of the 404 permit that is issued by the appropriate Corps of Engineers district.

The state and federal agencies that have a role in regulating or managing state resources have developed a general permit for sand and gravel mining. The permit is issued to regulated operations unless they are mining in an environmentally sensitive watershed such as the Eleven Point River, in which case an individual permit must be issued.

The 404 general permit regulates many practices that are detrimental to streams. It specifies buffer zones, prohibits removal below the elevation of the waterline and modifications to the watercourse, and requires revegetation and protection of disturbed areas. Seasonal restrictions protect some spawning areas. These practices, if followed, do much to preserve the stream resources.

The Missouri Department of Conservation (MDC) has a significant advisory role in sand and gravel mining and the development of management practices. Fisheries personnel review the 404/401 general permits issued and often advise where the general permit allows discretion, such as buffer zones. Fisheries personnel can help mining operators and landowners in locating sites where they can remove gravel with minimal impacts to the stream. MDC will also become involved if mining causes a fish kill or other pollution incident.

DNR’s Land Reclamation Program (LRP) has regulatory authority over commercial surface mining operations, which would include removal of sand and gravel. Because of the change in regulatory authority, the Land Reclamation Program has assumed more authority over sand and gravel mining operations. Only commercial use is regulated. Authorities and personal use activities are exempt from Land Reclamation Regulations.

Under the Endangered Species Act, the U.S. Fish and Wildlife Service may provide comments on mining operations that may adversely affect rare and endangered species, or modify or destroy those species’ designated critical habitat.

Section 402 of the Clean Water Act requires an NPDES (National Pollutant Discharge Elimination System) permit, which is administered through the Missouri State Operating Permit program. Under this permit, the Missouri Department of Natural Resources regulates the washing and screening of gravel as a point source or wastewater discharge. Storm water runoff from sand and gravel mining is also regulated under Section 402 because federal and state regulations identify the activity as a regulated activity under Major Group 14 of the Standard Industrial Classification Manual (SIC Code), Mining and Quarrying of Nonmetallic Minerals. Both kinds of discharges are covered under one general permit written by the Department of Natural Resources, MO-G50. This permit uses effluent limits for settleable solids and pH as its

primary control mechanism. About 70 sand and gravel operations in the state are under this permit.

Environmental Effects

Sand and gravel mining that takes place along streams can adversely affect the water quality in many ways. Disturbance in or near the streambed can increase the turbidity of the stream. Environmental effects of increased suspended solids or settleable solids in streams include increased turbidity, reduced light penetration, reduced prey capture for sight feeding predators, clogging of gills/filters of fish and aquatic invertebrates, reduced benthic habitat, additional downstream transfer of phosphorus and nitrogen nutrients in stream sediments and reduced spawning and juvenile fish survival.

Other water pollution problems that sand and gravel mining may cause are litter and abandoned equipment left in or near the water. Fuel and oil from use or storage of equipment may also enter the stream.

Changes to the stream morphology caused by sand and gravel removal generally lead to the most damaging effects to waters. Accelerated changes to the streambed and banks lead to further changes in direction of flow and velocity of water, which can cause headcutting, other streambank erosion, and increased deposition of solids downstream. Streambank erosion can cause vegetation to lose anchoring for its root system and fall into the stream. Mining may remove vegetation entirely. These actions further de-stabilize the stream and accelerate the process of stream degradation. Removal of vegetation and its shading capacity can raise water temperatures, which can also lower dissolved oxygen concentrations, making the survival of stream biota more tenuous.

Management Practices

Good management practices can greatly reduce the detrimental environmental effects of sand and gravel mining. Commonly accepted practices, which have been incorporated into the 404/401 General Permit, are listed below. These management practices also provide guidelines for gravel removal by individuals or operations that are not required to obtain permits.

> Provision for undisturbed buffer zones between the water line and mining activities, between the bank vegetation and mining activities, and on the landward side of the bank is essential to maintain stream stability and water quality.
>
> Excavation of material should not go below the elevation of the water at the time of removal.
>
> Gravel washing or sorting should be conducted above the stream or riverbanks, and so that material will not wash back into the water during rainfall events.
> Gravel should not be pushed up against the stream banks.
>
> Vehicles and other equipment should be limited to removal sites and existing crossings. Where fording is necessary, streams should be crossed perpendicular to the channel.

Fuel, oil, other petroleum products, equipment and any solid waste associated with the mining operation should not be stored between the stream and riverbanks.

Excavation of sand or gravel deposits should be limited to unconsolidated areas that contain primarily smaller material and that is loosely packed and contains no woody perennial vegetation greater than one inch in diameter, measured at breast height.

Where water is flowing or would flow after rain, the channel should not be relocated, straightened, or otherwise modified.

Contractors and workers should be trained in the management practices necessary to protect the stream.

Future

The General Permit is intended to keep sand and gravel operations out of the water, and goes far in specifying the management practices needed to protect the stream. However, with the reduction of COE authority, these management practices are no longer required for sand and gravel operations unless they become part of the LRP permit. Again, this has resulted in a significant loss of regulatory control and it appears that sand and gravel operations now pose a much greater threat to the quality of Missouri's streams.

An educational effort could enhance the effectiveness of sand and gravel management. Many state and federal entities are involved in managing sand and gravel activities. The number of agencies and their respective jurisdictions, requirements, and responsibilities are confusing to those not involved in day-to-day governance. Although the 404/401 General Permit goes a long way in combining and specifying many regulatory requirements, sand and gravel operators, even if still regulated, still may not be well informed about appropriate mining methods and requirements. Missouri's Land Reclamation Program has developed guidelines and an information network to assist the mining industry in their efforts to mine in an environmentally safe manner. The Missouri Department of Natural Resources also provides industry assistance through their Outreach and Assistance Program.

STOWAGE AND LAND DISPOSAL OF WASTES

BOAT SEWAGE

Congress passed the Clean Vessel Act (Public Law 102-587, subtitle F) in 1992 to help reduce pollution from vessel sewage discharges. All recreational boats with installed toilet facilities must have an operable marine sanitation device (MSD) on board. When operating a vessel on a body of water where the discharge of treated or untreated sewage is prohibited; the operator must secure the device in a manner, which prevents any discharge. In Missouri, all waters of the state, with the exception of Bull Shoals Lake and the Mississippi and Missouri Rivers are listed as no discharge zones (NDZ).

Marine Sanitation Device

Federal Law prohibits the discharge of untreated sewage from vessels within all navigable waters of the U.S. There are three types of sewage treatment devices allowed for marine sanitation. Type I and II treat the effluent, while Type III holds the effluent until it can be pumped out, at a marina pump out station. Type I Flow-through device is suitable for vessels equal to or less than 65 feet in length. The effluent produced must not have a fecal coliform bacteria count greater than 1000 per 100 milliliters and have no visible floating solids. Type II Flow-through device is for vessels greater than 65 feet in length. The effluent produced by Type II must not have a fecal coliform bacteria count greater than 200 per 100 milliliters, and suspended solids not greater than 150 milligrams per liter. Type III – Holding Tank is used on vessels of any length. Boaters with Type III MSS can use any of the pump out facilities located throughout the state.

No Discharge Zones

A No Discharge Zone, is a designated body of water in which the discharge of ALL boat sewage, treated or untreated is prohibited. Boats equipped with Type I or Type II MSDs traveling in NDZ waters must secure the device in a manner that prevents any discharge. Missouri requires Y-valves to be locked in all state jurisdiction water, and prohibits Y-valve through hull discharge NDZ waters.

Enforcement of NDZ

The U.S. Coast Guard and the State in which the No Discharge Zone has been designated have enforcement authority of the NDA for vessel sewage. Penalties for misuses or failure to use MSD as well as illegal dumping of MSD in Missouri is $1000 fine or up to 1 year imprisonment.

DOMESTIC SLUDGE LAND APPLICATION

Characterization

Sewage sludge is the inevitable end product of domestic wastewater treatment. Many of the organic solids, toxic organic chemicals, and inorganic chemicals are removed from wastewater and concentrated in the sludge. An estimated 250,000 dry tons of sludge are generated in Missouri from wastewater treatment plants. Of this total, about 60 percent of the sludge is incinerated, 30 percent is applied onto agricultural land, 7 percent is in sludge holding lagoons

and the remaining 3 percent is hauled to landfills. Land application of sludge for beneficial use is the preferred utilization method.

Land application of municipal wastes in Missouri is practiced for its beneficial effects on soils and crops and for the purpose of using the soil's physical, biological and chemical capabilities to degrade the waste products. However, before this material can be spread on the land, the material has to meet both federal and state standards governing the use and disposal of domestic wastes.

The name "biosolids," a term coined by the Water Environment Federation, has been adopted to apply to domestic sludge that meets treatment process criteria for both pathogens and metal pollutant limitations for beneficial reuse. The term was developed to identify sludges that are treated and managed for beneficial reuse and to promote wider acceptance of the product.

Although biosolids are suitable for use as agricultural fertilizers or soil conditioners when current standards are followed, most Missouri biosolids generators still approach biosolids as a disposal problem rather than as a marketable resource. Based on previous annual biosolids reports, improper sludge management practices are still widespread, despite the existence of land application guidelines. It should be mentioned however that the number of generators mishandling biosolids is decreasing, due primarily to more awareness of the biosolids standards.

Many public and private facilities do not have adequate storage for inclement weather conditions, thus biosolids are land applied at inappropriate times when contaminants such as bacteria, heavy metals and various forms of nitrogen compounds are likely to be washed into streams during storm water runoff or snow melt. In areas of karst topography and highly permeable soils, improper biosolids application may cause groundwater contamination due to translocation of excess nitrogen and disease-causing organisms.

Public acceptance of biosolids in Missouri is generally favorable, as evidenced by a long history of biosolids land application onto cropland. Prior to 1979, there were no specific state guidelines on sludge use and disposal. In 1979, state rules under Chapter 8.170, Sludge Handling and Disposal, established a general framework for sludge use and disposal. The general framework led to the development of state standards and guidelines for sludge disposal. These were published in 1982 in a DNR report, "Agricultural Use of Municipal Wastewater: A Planning Guide." The publication was revised in 1985 to include similar limits for metals as those later published in 1993 in 40 CFR Part 503 sludge rule. This planning guide was discontinued in 1993 and replaced by NPDES Permit Standard Condition Part III and University of Missouri Water Quality Guide publications WQ 420 through WQ 449.
http://muextension.missouri.edu/explore/envqual/wq0420.htm

Potential NPS Pollution Impacts

Storm water runoff flowing over fields that have received biosolids is a potential source of nonpoint source solution. The impact of storm water runoff on surface water resources can be minimized if best management practices are followed. The applicable BMPs are covered in University Publication WQ 426, and these include restricted use clause, harvest deferment,

nitrogen and phosphorus loading, set back distances, site restrictions due to soil and weather conditions.

The primary objectives of land application best management practices are to prevent the movement of pollutants, maximize the rate of biodegradation in the soil, and maintain the land's potential for future use. The amounts of plant nutrients, particularly nitrogen and phosphorus and the types of pollutants that can be applied per acre, or whole sludge application rate, are critical factors in land application. To avoid overloading soils, sludge or biosolids application rates should be carefully determined prior to initiating land application.

Regulatory Authority

Sewage sludge is considered a water contaminant under both the federal Clean Water Act and the Missouri Clean Water Law. It is recognized as potentially harmful because it contains chemical pollutants and pathogens that may impact both human health and the environment.

In 1993, the EPA under the directive of the federal Clean Water Act, promulgated standards for use or disposal of sewage sludge, 40 CFR Part 503, also known as the sludge rule. This rule defines acceptable management practices and provides specific numeric limits for selected chemical and pollutants and pathogens applicable to land application of sewage sludge. The sludge rule is self implementing and directly enforceable by the EPA. The sludge standards are included in all NPDES operating permits issued to POTWs or other domestic treatment works.

The Missouri Clean Water Law regulates sewage sludge land disposal under Chapter 644 RSMo and 10 CSR 20 chapters 6,7 and 8. The current Missouri biosolids management program operates under the state permit rules and the delegated NPDES permit program for wastewater treatment facilities. Missouri incorporated Part 503 standards by reference into our state regulation under 10 CSR 20-7.015 (9) (F), which became effective May 9, 1994. However, the state is not delegated to run the federal sludge program, so EPA currently handles enforcement of 503 rules and the state addresses only water quality related violations.

In order to implement both federal and state sludge standards, the Missouri Department of Natural Resources and the University of Missouri Cooperative Extension Services developed a set of user friendly guidance documents to assist the permittees. These standards are designed to protect human and animal health and the environment by promoting safe use or disposal of biosolids. The Standard Conditions Part III for NPDES permits incorporates the University Extension water quality guidance documents by reference. The following water quality guides are issued with NPDES permits:

WQ 422 Land Application of Septage
http://muextension.missouri.edu/explore/envqual/wq0422.htm

WQ 423 Monitoring Requirements for Biosolids Land Application
http://muextension.missouri.edu/explore/envqual/wq0423.htm

WQ 424 Biosolids Standards for Pathogens and Vectors
http://muextension.missouri.edu/explore/envqual/wq0424.htm

WQ 425 Biosolids Standards for metals and Other Trace Substances
http://muextension.missouri.edu/explore/envqual/wq0425.htm

WQ 426 Best Management Practices for Biosolids Land Application
http://muextension.missouri.edu/explore/envqual/wq0426.htm

INDUSTRIAL SLUDGE AND WASTEWATER LAND APPLICATION

Characterization

This section addresses land application of industrial wastes under the Missouri Clean Water Law and regulations. Concentrated animal feeding operations are a sub-category of industrial wastes but are covered separately under the agricultural-livestock section of this document. "Land Application" does not include land disposal activities covered under the Missouri Solid Waste Management Law or the Missouri Hazardous Waste Management Law.

The definition of industrial waste sources under the Missouri Clean Water Law includes all facilities that are not domestic wastes. Domestic waste means sewage originating primarily from human sanitary conveniences and includes both publicly owned treatment works (POTW) and private domestic wastewater from residential and commercial sources.

Industrial land application facilities may include treated wastewater, wastewater sludges, biosolids or other residuals. Industries may land apply part or all of their waste materials depending on waste characteristics, regulatory requirements, permittee desires and site-specific factors. For example, an industry that is connected to city sewers will likely need to provide pretreatment of the wastewater prior to sending to the city, thus producing a pretreatment sludge that must be disposed by land application or other methods.

Industrial wastewater treatment facilities are required to meet the state effluent limitations in 10 CSR 20-7.015(9)(G). This rule requires use of the applicable pollutant control technology currently effective as published by EPA in 40 CFR 405-471. If there are no EPA standards available or applicable, the rule requires the department to set specific parameter limitations in proposed operating permits using "best professional judgement" (BPJ). The BPJ process establishes limits that will comply with Water Quality Standards for surface and subsurface waters under 10 CSR 20-7.031. In certain environmental settings, a higher level of wastewater treatment beyond EPA standards is required to protect especially sensitive water resources such as losing stream settings, karst topography, recreational streams, wild and scenic rivers, and other high quality or pristine areas. Land application is one of the preferred options in these sensitive areas because irrigation can provide treatment and reuse of wastewater that can achieve tertiary treatment or better depending on the specific irrigation design.

Land application may include one or a combination of the following:

a) Consumptive water uptake by plants;
b) Agronomic rates for utilization of nutrients and trace elements by growing plants; or
c) Land treatment based on utilization/treatment/immobilization/attenuation factors for soil-pant system.

The type of land application system and acceptable land application rates depend upon many site-specific factors. The most common land application system in Missouri is the "no-discharge" system which provides complete storage of wastes for winter and inclement weather conditions and land applies the wastewater and/or sludges during the growing season at agronomic application rates for utilization in production of agriculture or timber crops (combination of options a and b, above). When designed and operated properly the "no-discharge" system will have releases only due to chronic storm events exceeding the 1-in-10 year annual precipitation or catastrophic events exceeding the 25-year, 24-hour rainfall event. Therefore, no-discharge does not equal zero discharge during these extreme rainfall events.

Potential NPS Pollution Impacts

Stormwater runoff flowing from land application fields and wastewater percolation into groundwater are potential sources of nonpoint source pollution. For a properly operated facility, nonpoint source impacts would be similar to other comparable agricultural fields. In contrast, poor operation and maintenance will result in significant discharges of pollutants due to over-application, spills, bypassing or other operation problems. Pollutants of concern are potential disease-causing organisms, nitrates, ammonia, phosphorus, boron, chlorides, sodium, NPDES priority pollutants and any other potentially toxic chemicals used at the industrial facility.

The proper design and operation of the pretreatment, storage and irrigation components minimize these potential impacts. Pretreatment of industrial wastes is required to reduce pollutants to acceptable levels prior to land application. Best Management Practices are established under state rules at 10 CSR 20-8.020, Section (15). Additional management practices to address site-specific factors must be addressed in the engineering report and operation plan required by 10 CSR 20-8.020, Section (3). Critical factors for land application are soil characteristics, soil depth, depth to groundwater, geologic conditions, topography, erosion control, vegetation management, nutrient loadings, hydraulic loading rate and concentration and loading rates for other pollutants. Although, the land application system is a relatively simple operating system, it will not operate itself. Proper operation, maintenance and monitoring of the land application system must be provided on a continuing basis to achieve the desired environmental protection.

Regulatory Authority

Industrial land application systems must be permitted under the Missouri Clean Water Law and regulations unless specifically exempted in 10 CSR 20-6.015(3). Permitting requirements are under 10 CSR 20 Chapter 6 and include both construction permits and operating permits. Operating permits must be renewed at least every five years.

Permits rules require all applicants to submit an engineering report that evaluates the environmental and economic feasibility of no-discharge type facilities such as land application, recycling and reuse or other no-discharge options. The final decision on discharge versus no-discharge is left up to the permittee except for facilities located in certain sensitive watersheds identified in 10 CSR 20 Chapter 7, Effluent Regulations. When, the facility is located within 2 miles of a losing stream or other special stream categories, no-discharge is mandatory and new discharges are not allowed except where there are no other feasible options based on the criteria outlined in the Chapter 7 regulations.

No-discharge permitting requirements are under 10 CSR 20-6.015. Land application sites for certain industries must also comply with the storm water discharge regulations in 10 CSR 20-6.200. The permit application must include an engineering report, plans and specifications, geologic report, environmental assessment and an operating plan in accordance with 10 CSR 20-8.020 and 10 CSR 20-8.220. The application must address compliance with effluent limitations and water quality standards under 10 CSR 20-7.015 and 7.031 for both surface and subsurface waters.

The design regulations under 10 CSR 20-8.020, Section (15) require wastewater to be treated prior to land application and outlines other land application restrictions. Paragraph (3)(D) of 10 CSR 20-8.020, requires an environmental assessment as follows: "The engineering report shall contain a detailed waste description, laboratory analyses and documentation of the treatability and potential environmental pathways for each constituent that may be present in the waste and wastewater." Any waste that is classified as a "hazardous waste" pursuant to 10 CSR 25 must comply with the hazardous waste regulations under 10 CSR 25 and can not be land applied under 10 CSR 20 rules.

Operating permits include limitations and monitoring requirements, operation records and reporting requirements, best management practices and other special conditions. Storm water monitoring and groundwater monitoring is required where deemed appropriate. Monitoring reports must be submitted monthly, quarterly or annually depending on the size, complexity and location of the irrigation systems. Primary emphasis of the operating permit is to verify that the land application is being operated according to the approved plan and that water quality protection is maintained.

New permit application forms, "Form I" for wastewater and "Form R" for sludge/residuals, were first developed in October 1998 to specifically address land application facilities. These forms supplement other existing permit application forms. The Forms I and R contain a detailed list of supporting documentation needed to address the regulatory requirements and summarize the planned land application loading rates and operation and maintenance plans. The forms contain a detailed listing of testing requirements to characterize wastes and soils, and also include reference to other pertinent technical publications on toxicity and land application design parameters that must be addressed.

For additional reference information on land application, refer to the Proceedings of the Industrial Wastewater/Sludge Workshop, May 1997, University of Missouri-Columbia Extension Office. http://muextension.missouri.edu/explore/envqual/wq0427.htm

DOMESTIC WASTEWATER IRRIGATION

Characterization

Domestic wastewater means sewage originating primarily from human sanitary conveniences and includes both public owned treatment works (POTW) and private domestic wastewater from residential and commercial sources.

Conventional domestic wastewater treatment facilities are required to meet secondary treatment limits prior to discharge into state waters. In certain environmental settings, a higher level of wastewater treatment is required to protect especially sensitive water resources such as losing stream settings, karst topography, recreational streams, wild and scenic river ways, and other high quality or pristine areas. Wastewater irrigation is one of the preferred options in these sensitive areas because irrigation can provide treatment and reuse of wastewater that can achieve tertiary treatment or better depending on the specific irrigation design.

Wastewater may be land applied for either; a) consumptive water uptake by plants; b) for treatment and/or utilization of nutrients and trace elements onto vegetated land; or c) for land treatment/disposal. The type of irrigation system and acceptable land application rates depend upon many site-specific factors. The most common wastewater irrigation system in Missouri is the “no-discharge” system which provides complete storage of wastewater for winter and inclement weather conditions and land applies the wastewater during the growing season at application rates ranging from 12 to 24 inches/acre/year. At these low rates, the vegetation will uptake almost all of the applied wastewater if application rates are scheduled during periods when additional soil moisture can be utilized by growing vegetation. At higher application rates, the irrigation system provides a combination of water consumption, nutrient uptake and soil treatment of the applied wastewater.

Several hundred domestic wastewater irrigation systems are operating in Missouri. The oldest date back to the earlier 1970's. Two of the nations oldest wastewater irrigation systems are the cropland irrigation system at the City of Vandalia and the forest irrigation system at Bennett Spring State Park. Both have operated for over 25 years without problems.

Potential NPS Pollution Impacts

Stormwater runoff flowing from land application fields and wastewater percolation into groundwater are potential sources of nonpoint source pollution. Primary pollutants of concern are potential disease causing organisms, nitrates, ammonia, phosphorus, boron, chlorides and sodium. Other NPDES priority pollutants may be of concern for certain municipal systems with significant industrial sources. Pretreatment of industrial wastes is required to reduce pollutants to acceptable levels in the irrigation water.

The proper design and operation of the pretreatment, storage and irrigation components minimize these potential impacts. Best management practices are established under state rules at 10 CSR 20-8.020, Section (15). Additional management practices to address site-specific factors must be addressed in the engineering report and operation plan required by 10 CSR 20-8.020, Section (3). Critical factors for land application are soil characteristics, soil depth, depth to groundwater, geologic conditions, topography, erosion control, vegetation management, nutrient loadings, hydraulic loading rate and concentration and loading rates for other pollutants.

Regulatory Authority

All wastewater irrigation systems with flows exceeding 3000 gallons per day must be permitted under the Missouri Clean Water Law and regulations. Permitting requirements are under 10 CSR 20 Chapter 6. No-discharge permitting requirements are under 10 CSR 20-6.015. The permit application must contain engineering report, plans and specifications and operating plan in accordance with 10 CSR 20-8.020 and 10 CSR 20-8.220. Permitting requirements include limitations and monitoring requirements, operation records and reporting requirements, best management practices and other special conditions. Stormwater monitoring and groundwater monitoring may also be required where deemed appropriate. Monitoring reports must be submitted monthly, quarterly or annually depending on the size, complexity and location of the irrigation systems.

The design regulations under 10 CSR 20-8.020, Section (15) require wastewater to be treated prior to irrigation by a treatment process such as a wastewater treatment/storage lagoon or equivalent treatment system. Pretreatment must also be provided as necessary to meet the acceptable pollutant concentrations in the irrigation water. Pollutant criteria for irrigation water are provided in the EPA Process Design Manual on Land Treatment of Municipal Wastewater, publication number EPA-625/1-81-013, U.S. EPA, October 1981. A list of the key parameters for irrigation are contained in Table 4-5 "Suggested Maximum Applications Of Trace Elements To Soils Without Further Investigations," and Table 4-16 "Summary of Wastewater Constituents Having Potential Adverse Effects On Crops."

ON-SITE WASTEWATER DISPOSAL SYSTEMS

Missouri has widely differing geologic configurations and population densities. Karst formations and permeable soils of the Ozarks create a potential for groundwater contamination from on-site wastewater systems, a threat magnified by a rapidly growing population and increasing development. Additionally, much of this area has a shallow depth of soil to bedrock and sharp downgradients. The three fastest growing counties in the state during the 1990's are located in this area, with a majority of the land area not covered by sewer districts.

On the other hand, the tight clay soils of northern Missouri offer little absorption of moisture, greatly increasing the possibility that inadequately treated or untreated wastes will find their way into the lakes and streams of the state, or become ponded where incidental human contact may occur.

Regulatory Authority

The Missouri Department of Health and Senior Services (MDHSS) maintains statutory authority over on-site disposal systems under Sections 701.025 through 701.059 RSMo and implemented by 10 CSR 20-3.060, Minimum Construction Standards for On-Site Sewage Disposal Systems, and 19 CSR 20-3.070, Fees Charged by Department of Health for Inspection of Existing On-Site Sewage Disposal System Requested by a Lending Institution; and 19 CSR 20.3080, Description of Persons Qualified to Perform Percolation Tests or Soils Morphology Examinations in Determining Soil Properties for On-site Sewage Disposal Systems. Sewage treatment facilities that have a designed maximum daily flow or an actual maximum daily flow of three thousand

gallons or less fall under these sections. Single family residence lots of more than three acres are exempted. Systems with greater than three thousand gallons per day outfall and multiple lot systems that discharge are under jurisdiction of the Department of Natural Resources.

Section 701.038 RSMo limits complaint investigation to instances of communicable disease investigation and complaints by an aggrieved party or adjacent landowner. Section 701.040 requires MDHSS to develop a state standard for location, size of sewage tanks and length of lateral lines based on percolation or permeability rates of the soil, construction, installation and operation of on-site sewage disposal systems. The statute goes on to set requirements for inspections, permits, system modification or major repairs and contractor registration, and directs fees be collected.

With the aforementioned three-acre exception, anyone installing new on-site sewage systems or making major repair to an existing on-site sewage system must obtain a permit from MDHSS. Information must be provided on an application indicating the soil and site conditions, systems design, and setback distances. All factors must be acceptable to minimum construction standards before a permit will be issued. Law provides penalties for installation of systems without required permits.

The statutory and regulatory authority that exists is divided between the Missouri Departments of Health, Section for Environmental Public Health; and Natural Resources, Water Pollution Control Program. Authority of the Department of Natural Resources is in Chapter 644, RSMo, and 10 CSR 20, 1 through 9, and that of the MDHSS is RSMo 701.025 - 701.059, and 19 CSR 20-3.060, 070 and 080. A joint memorandum of June 18, 1996 delineated the areas of responsibility and cooperation between the two agencies (see Attachment A). Regulations for the design of small sewage works and standards for individual sewage treatment systems have been developed by DNR and are proposed rules (10 CSR 20-8.020, Design of Small Sewage Works, and 10 CSR 20-8.021, Individual Sewage Treatment Systems Standards).

Potential NPS Impacts

On-site sewage disposal is a necessity in much of the state with an estimated 500,000 subsurface disposal units in place, an unknown number of lagoons, and approximately seven to twelve thousand new systems being installed each year (MDHSS). The state law governing on-site sewage disposal has been greatly amended and there has been a corresponding dramatic increase in the number of local on-site sewage ordinances. As the new law becomes better known to installers and the public, and as local and state agencies become better equipped to manage the workload, installation of new systems and repair of existing systems should reduce the negative impact upon the public health and environment. However, absent actionable complaints, existing systems are grandfathered regardless of whether they are functioning properly. In addition, the law exempts many single-family residences with lots consisting of three acres or more from minimum construction standards. Therefore, malfunctioning existing systems, illegally installed new systems, and legally installed but inadequate systems can present the following problems in creating a threat to surface or groundwater.

1. Installation of an unsuitable system for a particular location. For example, an absorption field placed in the vicinity of sinkholes could allow septic system effluent a direct access to groundwater.

2. Installation of an otherwise appropriate system (for the area) on an improper site, i.e., an absorption field located in close proximity to a water well, possibly providing direct access to groundwater and the drinking water supply.

3. Under sizing of a disposal system caused either by faulty design before construction or by a change in usage after construction, resulting in inadequate treatment and/or discharge, potentially to waterbodies.

4. Installation of any type on-site disposal system in areas where soils, geology or lot size are prohibitive. Results are the same as 3.

5. Use of inappropriate materials or poor workmanship during construction. (Same as 3.)

6. Lack of adequate maintenance of an appropriate system, i.e., no schedule of routine pumping of septic tank sludge. (Same as 3.)

Best Management Practices
Use of best management practices could contribute to a decrease in water quality problems caused by on-site wastewater systems.

1. Have the proposed site evaluated by a knowledgeable person using information from soil morphology or percolation tests and other relevant data.

2. Locate the system at the best possible site on the lot. Besides following the recommendations outlined in #1 above, do not install drainage fields upgradient from major karst features, domestic wells or surface water.

3. Submit an application for a permit, if required, to MDHSS or DNR and obtain the necessary permit(s).

4. Follow construction standards for the recommended system. Use appropriate materials and correct installation techniques.

5. Use the system as originally designed. Don't overload by practicing water conservation.

6. Maintain the system appropriately.

7. Consider the use of advanced on-site systems other than the traditional septic tank/drainage field or lagoon when the system has to be installed in areas where depth to bedrock is shallow, karst features are identified or the drainage field will be upgradient to domestic wells or surface water.

Systems primarily used in Missouri are the septic tank followed by absorption field and the facultative lagoon. However, as not all soils will allow conventional septic tank/absorption field installation, alternative systems should be considered. Depending on soil and site conditions, alternatives would be:

1. Mound system
2. Low pressure system
3. Sand filter
4. Drip irrigation
5. Gravelless absorption field
6. Wetland
7. Land application
8. Water conservation
9. Separation of gray water
10. Holding tank
11. Peat Moss Bio-filter
12. Other site specific innovative systems

Text reproductions of the original letters.

This MOA was updated in Dec. 2003, but was unavailable during latest revision.

M E M O R A N D U M

DATE: June 18, 1996

TO: DEQ Regional Directors
DEQ Water Pollution Control Program Staff
DEQ Technical Assistance Program
DGLS Environmental Geology Program
DOH District Environmental Sanitation Supervisors
Local Health Agencies and other Agencies
Administering Sewage Programs

FROM: John A. Young, Director
Division of Environmental Quality
Department of Natural Resources

Pamela Rice Walker, Director
Division of Environmental Health & Epidemiology
Department of Health

SUBJECT: DNR – DOH Jurisdiction and Cooperation with
Sewage Problems

Over the years, there have been occasions when it was not clear which agency was responsible for particular sewage systems. In particular, DNR's or DOH's policies and procedures regarding septic tank requirements have been confusing. The passage of Senate Bill 446 (which amended the law for small on-site sewage systems) accentuates the need for distinguishing agency jurisdiction. The following table provides a division of responsibility for review and permitting:

RESPONSIBLE AGENCY FOR REVIEW AND APPROVAL

		DOH	DNR
1.	FOR A SINGLE FAMILY RESIDENCE <3000 GPD	X	
2.	FOR OTHER SOURCES OF DOMESTIC SEWAGE FLOWS <3000 GPD, INCLUDING MULTIFAMILY, COMMERCIAL, AND RESTAURANTS WHICH DISCHARGE INTO SUBSURFACE SOIL ABSORPTION SYSTEMS OR HOLDING TANKS[2]	X	
3.	FOR INDUSTRIES, WHICH INCLUDES WASTES NOT DEFINED AS DOMESTIC SEWAGE[3]		X
4.	FOR OTHER SOURCES OF DOMESTIC SEWAGE FLOWS <3000 GPD, INCLUDING MULTIFAMILY, COMMERCIAL, AND RESTAURANTS THAT DO NOT DISCHARGE INTO SUBSURFACE SOIL ABSORPTION SYSTEM (e.g., discharge to lagoons)		X
5.	FOR ANY SOURCE WITH A FLOW THAT IS >3000 GPD		X
6.	FOR APPROVAL OF WASTEWATER TREATMENT IN SUBDIVISIONS > 15 LOTS[4] (3-14 lots not now regulated)		X

1. Includes day cares licensed for up to 10 children that produce domestic sewage and does not change the overall predominant use of the structure as a single-family residence.
2. Calculations of GPD for on-site systems will be made according to the DOH rule.
3. Domestic sewage is defined in 701.025.(12) as: "…human excreta and wastewater, including bath and toilet waste, residential laundry waste, residential kitchen waste and other similar waste from household or establishment appurtenances…"
4. DNR's regulation defines a subdivision as 15 lots, however, subdivisions are now defined in RSMo. Chapter 701.025 as 3 lots. (Outside of the definition given in this statute, the new law does not mention the word "subdivision" again.) DNR will be working to amend its rule to make it consistent with state law within the resources available. The matter of obtaining resources to address the additional numbers of subdivisions between 3 and 14 lots is staggering. DOH personnel are requested to be patient and understanding of the time it may take for DNR personnel to respond to the workload. DOH personnel should be very aware that it may be more than a year before DNR has completed the administrative rules process to revise its subdivision regulations.

The appropriate DNR regional office to obtain the proper permits. Residential, food service establishments, lodging rule for on-site sewage systems directs developers of subdivisions to first contact DNR before going to DOH for an application for a permit. The intent is to route all regulated subdivisions through DNR to determine whether central sewers are required. If DNR determines central sewers are not required, the individual on-site systems will be reviewed and permitted by DOH personnel. Communication between the respective DNR and DOH offices is essential.

DNR does not review and permit on-site installations for individual residences in a subdivision. DNR uses generalized screening criteria to determine if centralized sewage collection and treatment is required or if on-site systems may be used in a subdivision. DNR regulates the developer of the subdivision and not the individual lot owner. If an engineer's report is required to make this determination, DNR will require soils information and generic designs of on-site systems to be used in the subdivision. (The generic designs are intended as an example of the on-site systems that will be used and should not be construed as a mandatory requirement for any particular lot.) Please be aware that an engineer's report is not mandatory in small subdivisions with fewer than 50 lots. The small subdivisions may only have a favorable geological evaluation for approval to use on-site systems.

Until DNR revises the subdivision regulations, 10 CSR 20-8.021 will be used for review of the engineer's reports. DNR intends to revise the subdivision regulations so that environmental considerations and the practicality of using on-site systems in a subdivision will be the focus of the rules. Design criteria, that may be referenced in the subdivision regulations, would be based upon 19 CSR 20-3.060. During revision of the subdivision regulations, DNR will greatly appreciate any and all input as to locations where subdivisions should have central sewers and where on-site systems are safe for the environment and public health. The basic premise that DNR will be working under is that if sewers are needed in a subdivision, they should be constructed before any lots are sold or houses constructed.

According to the state's Clean Water Law, RSMo. Chapter 644, it is unlawful for any person to build, alter, replace, operate, use or maintain any water contaminant or point source in this state that is subject to permit from DNR. Exceptions to obtaining permits from DNR are as follows:

1. A system that serves a single-family residence. Such may include an in-house business such as a day care licensed for up to 10 children or a beauty shop, provided the additional wastewater is domestic and 50% or less of the total design flow. (Please note that the intent of the subdivision regulations is to maintain wastewater on the property of origin.)

2. A system that receives 3000 GPD or less of domestic sewage and discharges into a soil absorption system.

3. Certain "no-discharge" systems utilizing sealed lagoons with storage and disposal by land application. These systems may not require permits, however, they are still subject to DNR regulations, review and approval to insure they are in fact "no discharge."

All other surface discharge systems whether or not the design flow is less than 3000 GPD must have a construction permit from DNR. Commercial systems with flows less than 3000 GPD that handle only domestic sewage do not need to be routed through DNR if the wastewater will be disposed of into a soil absorption system that complies with DOH’s state standard. If an applicant proposes to discharge into a soil absorption system that does not comply with the DOH standard or otherwise would surface and discharge, please refer him/her to the

appropriate DNR regional office to obtain the proper permits. Residential, food service establishments, lodging establishments and office buildings are all considered to produce domestic type sewage. Most manufacturing plants, and places where petroleum products and solvents are routinely handled, e.g., service stations, are considered potential sources of industrial wastes and should be routed through DNR for a determination of permit authority.

Revisions to amend the portions of the DOH rule that allowed discharge are being drafted cooperatively by our staffs to provide better assurance the Clean Water Law will not be violated. (Originally, DOH thought that allowing discharges from sand filters and wetlands would provide better effluent quality than with lagoons. However, potential conflict with the Clean Water Law makes it necessary for DOH to amend this portion of their rules.)

Variances will be allowed for some existing malfunctioning systems that serve single family residences. Whenever effluent can be realistically contained in a soil absorption system, that should be required. However, there will be cases where, due to small lot size, poor soils, and other restrictive features, it will be difficult or cost prohibitive to maintain the effluent in the soil, much less contain it on the property. In these cases, upgraded pretreatment and as much soil absorption as possible shall be used to produce the highest quality effluent possible before any portion of the effluent is discharged or leaves the property. This is not a complete solution, but may be the best possible response given certain locations' restrictive conditions. This paragraph only applies to single family residences.

If there are several malfunctioning on-site systems in an unsewered neighborhood, DNR and DOH will cooperatively promote the installation of a community system.

Other questions requiring the clarification of agency jurisdiction may occur in the future. With continued communication and cooperation, both agencies intend to work out situations with the goal of better serving the public.

SOLID WASTE LANDFILLS

Characterization
Solid waste landfills fall into four categories:

1. Sanitary landfills - municipal and commercial solid waste
2. Demolition landfills - building construction and demolition waste
3. Special Waste landfills - wastes which require special handling - such as foundry sand, wastewater and drinking water sludge, and ash from wastewater sludge incineration
4. Utility Waste Landfills - Fly and bottom ash from coal fired utility boilers

There are currently 36 active landfills (24 sanitary, 4 demolition, 3 special waste, 5 utility) accepting waste in Missouri. Missourians generate trash, including industrial waste, at a rate of approximately 7.9 million tons per year and dispose of 5.5 million tons in landfills. Costs for landfilling are approximately $27.50 per ton and rising. Alternative waste management options, such as composting and recycling, have increasingly become important components of solid waste management.

In 1989, there were only 4 large-scale yard waste composting facilities in the state. In 1996, there were 97 sites. This exponential growth in the number of composting facilities in the state is primarily the result of yard waste being banned from landfills effective January 1, 1992. The yard waste ban has successfully reduced the amount of waste being disposed of in landfills. There is also a growing interest in composting and co-composting other organic materials such as food waste, wood waste, and paper because of the success that yard waste composting has enjoyed. A processing permit from the Solid Waste Management Program (SWMP) is not required for yard waste composting but may be required for other organic material composting.

Recycling has also increased dramatically during the 1990's. The number of communities with access to recycling services rose from 47 in 1989 to 358 in 1996. Recycling drop-off sites and recycling processing centers that only take source-separated recyclables do not require a solid waste processing permit. Because many of these recycling centers store material outside where it may come in contact with the elements, they may be required to have a state operating permit, issued by the Water Pollution Control Program, to discharge stormwater.

No matter which waste management option is used, properly disposing of our trash is neither inexpensive nor without potential nonpoint source (NPS) problems; the public ultimately bears the costs of disposal and related environmental protection. A 1999 report published by DNR, entitled "The State of Garbage in Missouri" can be viewed at the following link:
http://www.dnr.mo.gov/oac/pub2072.pdf

Potential NPS Problems
Leachate entering groundwater and uncontrolled runoff are potential NPS problems associated with solid waste management. Current design requirements for the expansion of existing landfills and for establishing new landfills help prevent leachate problems. However, older landfills that were not constructed under these stricter design requirements pose the most likely source of leachate NPS pollution. Efforts to minimize leachate generation at these older landfills may include a cap placed on the landfill at closure to prevent stormwater infiltration into the

wastes and use of dense stands of vegetation, berms, diversion channels, catchment basins, etc., to manage stormwater run-off and run-on. However, most of these landfills ceased accepting waste years ago and many were not properly closed. Most have no post-closure requirements or financial assurance instruments to address leachate problems if they arise. Many have no viable responsible party.

Illegal dumps - uncontrolled and unpermitted dump sites - are primarily an aesthetic problem with some potential for NPS pollution. Because such dump sites are frequently ravines, stream banks, roadside ditches or sinkholes, substances which have been carelessly discarded may find their way into waters of the state. The extent of water pollution from illegal dumps is not documented.

Regulatory Authority
Missouri DNR's SWMP closely regulates solid waste disposal activities in order to prevent the occurrence of significant problems resulting from landfilling waste (RSMo 260.200-260.345, 10 CSR 80 1.010-11.010). The entire set of solid waste regulations can be viewed at the following website: http://www.dnr.mo.gov/alpd/swmp/laws/rules.htm

Requirements for Existing Sanitary Landfills

A. Composite liner - A liner of a landfill consisting of a soil component and a geomembrane component. The soil component has a hydraulic conductivity equal to or less than 1×10^{-7} cm/sec. The intimate contact between these two liners retards the migration of leachate through the liners into the groundwater.
B. Leachate collection system - A permeable layer placed below the waste deposit and above the composite liner that drains the leachate from the landfill to prevent it from migrating through the liner into the groundwater.
C. Run-on control - This control is primarily a set of ditches and berms that prevent stormwater from getting into the waste deposits.
D. Run-off control - This control is also primarily a set of ditches and berms that prevent water that comes in contact with the waste deposit from getting into the stormwater drainage systems.
E. Erosion control - The best erosion control is a hardy stand of vegetation. Terraces, rip-rapped ditches and other devices are used in combination with the vegetative cover to control erosion on a site.
F. Landfill gas control - Landfill gases, primarily methane and carbon dioxide, are produced by decomposing waste. The predominant gas targeted for control is methane. New federal regulations require the control of Non-Methane Organic Compounds (NMOC) by the collection and burning of methane gas. Landfill gas has the potential to degrade groundwater, and methane poses a serious human health threat of explosion or asphyxiation if it accumulates in confined spaces.
G. Groundwater monitoring - Baseline data is required prior to operation and semi-annual monitoring must be performed to verify that leachate is not migrating through the landfill's liner into the groundwater.
H. Operator training - A certified solid waste technician must be on staff to make sure that the landfill is operating in accordance with regulatory requirements.

I. Financial responsibility - A corporation owning and/or running a landfill must show that they have the financial capability to close the site and care for it during a post-closure care period of thirty years.

J. Stormwater and land disturbance permits - State operating permits are required to discharge stormwater from the landfill property. These permits require specific erosion controls on areas of the landfill and borrow area(s).

Recommendations

Missouri's regulatory approach seems to be working well for active and recently closed facilities. Existing regulations have been revised to reflect changes in state statutes and federal regulations. Research has provided additional understanding of contaminant transport and effects on the environment. Regulations on stormwater and land disturbances have further reduced the potential for problems from surface water discharges to receiving streams and water bodies at active facilities.

There are over one hundred and fifty older landfills scattered throughout the state that don't have adequate funding to correct environmental problems. These older landfills were not constructed or operated like the modern subtitle D sanitary landfills we have today. The presence of these older landfills poses an unknown impact to the water resources of this state. No statewide assessment has been conducted; however, it is very possible that they are contributing leachate contamination to both surface and subsurface water.

The DNR's Solid Waste Management Program is currently evaluating the feasibility of conducting a study of these sites to determine potential and documented public health and safety problems, as well as environmental impacts such as NPS pollution. The ultimate goal of the study would be to promote and establish a solid waste remedial fund which can be used to take corrective action at these sites where needed, and where no responsible party is able to adequately respond.

HAZARDOUS WASTE

Characterization

The manufacture of many products that make life easier, safer, or more pleasant results in the generation of hazardous wastes. By Missouri law, hazardous waste is any waste or combination of wastes, which...may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness, or pose a present or potential threat to the health of humans or the environment. It includes wastes that are ignitable, corrosive, reactive, toxic or are listed as a hazardous waste in state or federal regulations. Some wastes, which are not found on the lists, may still be regulated as hazardous waste because they exhibit one of the four characteristics of being ignitable, corrosive, reactive, or toxic. Currently in Missouri there are 20,313 active and inactive registered hazardous waste generators, which includes out-of-state generators; 383 licensed transporters; 34 permitted treatment, storage, or disposal (TSD) facilities, 34 interim status TSDs, and 30 closed facilities. All permitted hazardous waste landfills, storage facilities, and incinerators are required to have stormwater permits.

Regulatory Authority
The Department of Natural Resources' Hazardous Waste Program is charged with protecting human health and the environment from possible threats posed by hazardous waste. To accomplish this goal, the program encourages the reduction of hazardous waste generation, regulates management of hazardous waste and oversees the cleanup of hazardous waste contamination in Missouri. The Missouri Hazardous Waste Law is in the Revised Statutes of Missouri (RSMo), Sections 260.003 to 260.575 http://www.moga.state.mo.us/STATUTES/C260.HTM and the Code of State Regulations, Title 10, Division 25 (10 CSR 25).

In 1995, responsibility for regulation of underground storage tanks and leaking underground storage tanks was added to the Hazardous Waste Program. The Program now regulates the management of underground storage tanks and administers the Underground Storage Tank Insurance Fund and oversees the cleanup of contamination in accordance with 319.100 through 319.139 RSMo.

The U.S. Environmental Protection Agency (EPA) has recognized the authority of the state to execute aspects of many federal laws including the following:

Resource Conservation and Recovery Act (RCRA) - regulates the "cradle to grave" handling of hazardous waste from generation to recycling, energy recovery, treatment or final disposal and mandates corrective action at hazardous waste management facilities.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) - also known as Superfund, oversees the cleanup of hazardous waste contamination.

Toxic Substances Control Act (TSCA) - regulates handling and disposal of many hazardous substances. The Hazardous Waste Program is authorized under TSCA to conduct compliance inspections for polychlorinated biphenyls (PCBs), and 10 CSR (Code of State Regulations) 25, Chapter 13 regulates proper transportation and disposal of PCBs.

Federal Facility Compliance Act (FFCA) - Requires federal entities to be subject to RCRA. This act also requires the U.S. Department of Energy to develop treatment technology for wastes that are both hazardous and radioactive, known as "mixed wastes."

Potential NPS Impacts
Spills or releases of hazardous waste or substances do occur. Transportation accidents, pipeline breaks, fires or other disasters have allowed hazardous waste pollutants to enter waters of the state. During the Fiscal Year 2003, the DNR's Environmental Services Program (ESP), Environmental Emergency Response (ERR) Section received a total of 3,851 calls reporting releases of hazardous substances. This number of incident reports is an eleven ~~nine~~ percent increase from the number of calls reported during Fiscal Year 2002. ERR staff responded on-site to approximately 700 of those reported incidents.

In Fiscal Year 2003, methamphetamine lab seizures accounted for 75% of the incidents reported, petroleum products accounted of 22 percent of the incidents reported. Agricultural chemicals were involved in 1.2% of the incidents reported. PCBs accounted for .23% of the incidents,

while sewage accounted for 1.7% of all calls received. Radiological substances were involved in only 0.29% of all incidents.

If the investigation of an incident reveals leakage to surface or ground water, fumes that may affect the public, bulged containers, and other unstable conditions, the department may declare the situation a hazardous substance emergency. An on-scene coordinator from the department's ESP, EER section will then determine what action is needed to stabilize the site and/or clean it up completely.

Hazardous materials NPS problems from leachate account for very few known water quality problems. Discharges to surface water or from leachate collection systems are designated point sources and addressed accordingly. Leachate entering groundwater may be considered a NPS; however, most problems are limited to pre-regulation landfills. Requirements for the expansion of existing landfills and for establishing of new landfills are designed to help prevent leachate problems.

Promiscuous dumps - uncontrolled and unpermitted dump sites - receiving hazardous materials have some potential for NPS pollution. Because such dump sites are frequently ravines, stream banks, roadside ditches or sinkholes, substances which have been carelessly discarded may find their way into waters of the state. However, the extent of water pollution from promiscuous dumps is not documented.

Recommendations

Missouri's Hazardous Waste Management Law seems to be working well. Existing regulations have been expanded and revised recently to reflect changes in state statutes. Regulations on stormwater runoff at all hazardous waste sites have further reduced any problems of surface water discharges to receiving streams and water bodies.

HYDROLOGIC/HABITAT MODIFICATION

Introduction

Hydromodification is the changing of the natural flow of rivers and streams through channelization, bridges, bank stabilization, cut-off devices, dredging, locks and dams, spillways, and watershed construction. Nonpoint source pollution associated with these activities includes sediment, nutrients, pesticides, various organic pollutants, and some inorganic pollutants associated with acids or metals.

From Webster's, habitat is defined as "the region where a plant or animal naturally grows or lives; native environment." A change in the native environment could result in a modification of the life ordinarily found there.

The watersheds of lakes and streams in urban and agricultural areas are clearly no longer ecologically the same as they were in presettlement days. More than 60 percent of the U.S. land surface is manipulated for human needs (urban development, forests, and agricultural areas) and more than 85 percent of the inland water surface area is artificially controlled. Surface water controls range from fixed weirs to multi-gated dams and extend from small farm ponds and streams to large rivers. Modifications to water bodies can benefit us in numerous ways. Lakes are created and stabilized at levels that provide reliable access for recreational boating and preferred rate of electrical generation. Rivers are maintained at appropriate levels for navigation of commercial barges and ships. Manipulation of water levels offers optimal flood protection and water supply for drinking and irrigation. Waterbody modification also may have detrimental effects on wildlife and other functions of aquatic ecosystems, and wetlands in the littoral zone suffer from either too much or too little water. Modifications may also impact important physical properties of the lakes and streams such as water residence time, water level, velocity, bedload, and basin morphology, are often modified. Dynamic hydrologic cycles are all but eliminated, causing the degradation of plant and animal communities as well as water quality.

Any activity that involves the alteration of waters of the state requires a federal and/or sometimes a state permit. Streams, lakes, reservoirs, and adjacent wetlands are all considered waters of the state. Federal permits, under Section 404 of the Clean Water Act, and subsequent state water quality certification, under Section 401, are required for projects involving the discharge of dredged or fill material into waters of the U.S. or wetlands. Examples of stream and lake alteration activities requiring permits include:

- Mining activities
- dredging, widening, straightening, bank stabilization
- levee construction
- channel relocation
- water diversions or dams
- water withdrawal structures
- flooding, excavating, filling or draining a wetland
- dock, lake wall, boat dock construction

Channelization
It is the nature of streams to flood and change course. Natural parts of this process are erosion of stream banks and deposition of streambed materials elsewhere. However, humans have not historically accepted this, trying to alter streamflow wherever possible. While they are generally trying to reduce flooding or stabilize shifting channels, they generally end up accelerating the natural process of stream dynamics. Flood control efforts such as levee construction and various channel modifications attempt to confine water to the channel during higher flow periods. All of these activities increase the volume and velocity of water within a stream during high flow periods. This increased energy worsens channel erosion and increases rates of bank failure, head-cutting, and down-cutting. In terms of physics, moving water has kinetic energy that will inevitably do work. The faster the water moves the more energy is within the system. The excess material transported by streams under such conditions is deposited at a point downstream where the rate of flow is slowed because of changes in gradient, blockages or other flow restrictions. With the next flow event the material is again carried to another deposition location. This process of erosion continues until flow rates become negligible. Such sediment "plumes" can be observed in the upstream portion of many man-made lakes as well as brackish estuarine areas.

Almost without exception, localized efforts to control the periodic flooding and natural shifting of channels result in the worsening of the very "problems" people try to correct. The more stream management problems are addressed in the context of an entire watershed, and the better we are able to understand and accommodate natural stream processes, the more successful our efforts will be. Channelization can result in an increase in stream bank erosion and erosion in upstream reaches and tributaries. Channelization causes turbidity, temperature increases, changes of dissolved oxygen concentration, reduction of habitat for aquatic life, and loss of wetlands. In Missouri, more than 2,200 stream miles have been degraded or lost due to channelization.

Persons considering any channel modification should address all other alternatives first in order to select the most environmentally f avorable solution practicable for the particular situation.

Dredging
Lakes - Lakes are reflections of their watersheds and as such receive sediment inputs from the landscapes they drain. At the point where water from a stream enters a lake the water slows down and the sediment load it is carrying is able to fall out of the water column. Over time the sediment builds up, bringing the lake bottom toward the surface and causing the water to become shallower. This is a natural and slow process in undisturbed watersheds; in developed watersheds the process is very rapid - leading to a lower ability to store water for drinking, irrigation, recreation and habitat. One way that increased sedimentation is dealt with in coves and entire lakes is by dredging.

From a habitat standpoint, if a lake is dredged completely it could take 2 to 3 years for the reestablishment of benthic fish-food organisms. However, if portions of the bottom are left undredged, reestablishment may be almost immediate. Dredging is expensive. In most cases, installment of best management practices in the watershed to protect the lake from sedimentation is economically more feasible as well as less damaging to aquatic life.

Streams - The most prevalent form of dredging in Missouri within streams and rivers is for mining of sand and gravel, navigation, or poor attempts at flood control. See previous subcategory entitled “Sand and Gravel Mining”.

Bridge Construction/Highway Impacts
Highway construction frequently includes bridge construction and, consequently, various levels of disturbance within stream corridors. Clearly we could not drive across even a single county in the state without building bridges, but there are potential problems associated with these conveyances. The potential for downstream streambank erosion resulting from the constriction of the floodway by bridge approaches or the bridge structure should be modeled or otherwise quantified. Any areas that may be subject to accelerated rates of erosion related to projects must be adequately protected to control erosion.

The following items should be considered when constructing bridges:

- Placement of permanent fill materials should not be allowed other than design approved bridge support structures and related bank stabilization materials placed below the high bank. Improperly placed materials could lead to habitat destruction and flow alteration.

- Temporary rock stream crossings, when necessary should be placed downstream of project areas and should be designed to minimize impacts on flow and be built to withstand expected floods. Removal of the temporary crossings should not be accomplished between March 15 and June 15 due to possible interruption of spawning season.

- Clearing of forest cover and development of hard surfaces such as rooftops and pavement increase nonpoint source loading and runoff.

- Altering the channel or otherwise moving the primary stream channel should not be done except for the minimum needed for bridge structure placement. Material should not be pushed against banks as an erosion control method. Gravel is not an effective material for use in streambank stabilization.

- Clearing of vegetation, including both standing and downed timber, should be limited to that which is absolutely necessary for construction of projects. Clearing limits should be specified in the project contract.

- Streambed gradient should not be altered through placement of new or removal of existing natural or manmade grade controls or through compaction of riffles. Upstream pool depth should be monitored and maintained during project construction. If bed material must be removed, even temporarily, appropriate measures should be taken to reduce upstream impacts to bed stability.

- All highway project areas disturbed should be revegetated with native vegetation as soon as possible to minimize erosion. A short-term cover crop should be planted as needed to minimize erosion on exposed soils and mulching should be used as necessary. Bottomland

trees should be planted to ensure long-term stability and restore riparian corridor habitat. Follow-up efforts to ensure adequate revegetation should be required.

- Sediment runoff and soil erosion must be minimized in order to reduce suspended solids, turbidity, and downstream sedimentation that may degrade water quality or habitat and negatively impact aquatic life. BMPs should be installed, monitored, and maintained to control erosion on all disturbed areas.

- All surfaces of any equipment used in waters known or suspected to contain the exotic zebra mussels (e.g. MS, MO rivers) shall be examined and scrubbed thoroughly and allowed to air dry for at least one week prior to use in a MO stream.

- Petroleum products, other chemicals and construction debris associated with bridge construction must be prevented from entering the water or otherwise contaminating the riparian environment, as per state law.

Streambank Stabilization, Destabilization, Removal of Vegetation
Increased sediment delivery resulting from deforestation has increased sedimentation and turbidity in downstream channels, lakes and reservoirs, with attendant loss of capacity for water storage and conveyance, recreational and aesthetic values, and quantity and quality of habitat for fish and wildlife.

When stream or river management actions are taken without recognizing interrelated stream variables such as velocity, depth, width, viscosity, parent material, pool-riffle interval, sinuosity, slope, sediment transport, bed-load transport, and bed form, serious damage can be done to the stream or river environment. Work should not take place without knowing whether the aquatic ecosystem is stable or adjusting to recent changes to the watershed.

Stream and riverine wetlands are often severely altered by incomplete planning. Their hydrologic regimes have been altered by dams, pumping, dikes, channelization, dredging, bank stabilization, and watershed development. Efforts to restore riverine wetlands are complicated by the hydrologic and sediment regime changes typical of most rivers, which make it impossible to return wetlands to their natural condition without massive removal of dams, channelization, and so on. However, there are measures that can be taken for increased water quality protection, fish and wildlife habitat, flood control, and bank stabilization.
The cost of streambank stabilization methods varies greatly. The least expensive techniques are the ones that involve using local materials, such as logs or boulders. Besides financial concerns, the type of stream and land surrounding it will influence what types of restoration techniques are used. Streambanks that have been denuded of vegetation will require replanting. The type of plants used will depend upon soil type, geology, weather conditions of the area, and streambank slope. In areas where vegetation must be established quickly, soil bioengineering techniques may be the desired choice. A good stream restoration practice for one area may not be good for another. For instance, trees in the stream may create severe obstructions in some areas, but in others they may be placed there purposely to create fish and wildlife habitat. Often, stream restoration techniques serve the double purpose of stabilizing streambanks and creating habitat.

In order to find the best solution that will be the least costly in the long run, landowners should seek professional advice about what stream restoration techniques to use.

According to the Riparian Restoration and Streamside Erosion Control Handbook, prevention of streambank erosion problems is less expensive than restoration. Preservation and protection of the natural meanders and the native streamside vegetation community are important to streambank protection. Some practical measures that can protect streambanks from erosion follow:

--Maintain an undisturbed buffer zone at least 100 feet wide on both sides of the stream This area needs the protection of a permanent vegetative root cover and mat to protect and stabilize the soil. Where adjacent slopes are steep, a wider corridor of woody plants and shrubs is appropriate.

--Restrict the operations of heavy machinery, construction, animal grazing, and other intensive activities within the buffer zone. These activities compact the soil, which decreases infiltration, percolation, and aeration, increases runoff, and thus cause the eventual destruction of plants, soil and habitat.

--Use best management practices for agricultural and forestry activities. In agricultural areas, field tillage should follow best management practices as outlined in other sections of the management plan. Maintain an undisturbed riparian corridor next to the stream. Eliminate livestock access to streambanks. Stock watering areas can be used to limit access and should be stabilized by materials that can withstand trampling.

--Plant vegetation. Where existing vegetation is sparse, planting site-specific native plants can be less expensive, offer higher survival rates and give more protection than ornamental or non-native plants. Native self-maintaining perennial species can be selected and planted.

--Don't straighten channels. People often think that straightening the channel is the quickest and easiest solution to their erosion problem. Past experience has shown that channel straightening will simply change the location and nature of the erosion problem and usually make the problem worse.

With a little effort and within a short time, landowners can successfully implement streambank stabilization and riparian restoration techniques. Nature, given a little assistance, can begin to repair the damage caused by manmade and natural events. This leads to a reduction in tons of soil lost from eroding fields and streambanks, increased wildlife habitat, and better understanding of the importance of aquatic resources by landowners."

Wetlands

Wetlands maintain water quality by trapping, precipitating, transforming, and recycling a number of pollutants such as sediment, nutrients, heavy metals, and organic materials. They have properties of both aquatic and terrestrial ecosystems. One of their most widely valued functions is providing habitat for fish, birds, and other wildlife. More than one-third of the federally

endangered and threatened plants and animals require wetland habitats during some portion of their life cycle.

Their position in the landscape, whether as isolated wetland or floodplains contiguous with rivers and streams, also gives wetlands a major role in storage of floodwater and abatement of flooding. Wetlands intercept storm runoff and release floodwaters gradually to downstream systems. Because it is usually the peak flows that contribute to flood damage, wetlands reduce the impact of flooding. When wetlands are converted to systems that are intolerant of flooding (drained agricultural lands, filled developed lands), their storage capacity decreases and downstream flooding occurs. That flood protection values are real is supported by experiences where flood protective functions have been lost. Along the Mississippi River, constructing levees and draining the floodplain have reduced floodwater storage from an estimated 60 days to 12 days because waters can no longer spread out and be absorbed by the broad floodplain. The results have been annually recurring floods along the lower Mississippi River. As water floods into wetlands from rivers and streams, its velocity decreases, causing an increase in sedimentation. Thus, chemicals adsorbed to sediments are removed from the water and deposited in the wetlands. A variety of anaerobic and aerobic processes function to precipitate or volatilize certain chemicals from the water column. The accumulation of organic peat that is characteristic of many wetlands can ultimately lead to a permanent sink for many chemicals. The high rate of productivity of many wetlands can lead to high rates of mineral uptake by, and accumulation in, plant material with subsequent burial in sediments. Shallow water coupled with the presence of emergent vegetation leads to significant sediment-plant-water exchange.

In Missouri, more than 90% of the wetland habitat base has been lost. In most physical alterations of waterways, the wetland ecosystem is obliterated. Biological, chemical, and physical alterations often occur together, and the result is a cumulative impact that may well exceed the “sum” of the individual disturbances.

Wetlands Mitigation Banking

Under Section 404 of the Clean Water Act, anyone wishing to deposit dredge and fill materials in a wetland must follow a prescribed sequencing process. The first step in the process is to make all attempts to avoid impacts to jurisdictional wetlands, second is to minimize the impacts, and third is to mitigate for wetland impacts. In Missouri, several Wetland Mitigation Banks are currently in use. These banks are areas of land set aside for the restoration or creation of wetlands. If a 404 applicant has exhausted the sequencing process and has no on-site area that can be used to mitigate for the wetland impacts, then the applicant can purchase credits in the wetland bank that can be used as mitigation.

The Natural Resources Conservation Service and the American Farmland Trust along with the U.S. Army Corps of Engineers, Environmental Protection Agency, U.S. Fish and Wildlife Service, Missouri Department of Natural Resources, and Missouri Department of Conservation have approved the first wetland mitigation bank in the nation specifically designed for farming activities. This pilot mitigation bank, located in the “Bootheel” region of southeast Missouri and operational since 1999, has been established to offset impacts associated with the conversion of farmed wetlands (i.e., frequently cropped wetlands that have been altered to improve drainage). Some farmed wetlands have significant functions well beyond their small size, with respect to

flood control, water quality and wildlife habitat. However, most are farmed on a yearly basis and their functions continue to degrade over time. This workable mitigation program continues to benefit producers through increased crop yields while providing environmental benefits through the restoration and permanent protection of wetlands.

Habitat Protection/Restoration Practices
Restoration is possible and the following steps from the Riparian Restoration and Streamside Erosion Control Handbook should help (remember that any activity that involves the alteration of waters of the state requires a federal and possibly a state permit):

Speak to your upstream and downstream neighbors to determine if they too have problems, and if they would participate in a repair project.

Take steps to ensure that soil does not get pushed or washed into the stream. Install and maintain sediment control devices where needed.

If you are doing restoration work start at the upstream end and work your way downstream.

Do not implement measures that restrict the size of the channel. Practices that restrict channel flow can cause flooding or increase erosion.

Do not use materials that can be detrimental to aquatic life such as asphalt for riprap or wood treated with pentachlorophenol (PCP) or creosote.

Keep the stream channel and the banks as natural as possible to maintain habitats for fish, aquatic organisms, birds and animals.

Begin and end all streambank protection projects at stable points along the bank. This may be a point at which the main thrust of the flow is parallel to the bank, or at a stable structure such as a bridge or culvert. This may require cooperative efforts by several landowners.

Divert intensive sources of runoff such as gutter downspouts or street drainage away from the area to be treated, and be sure to include appropriate drainage facilities for this flow.

Make sure you have protected the submerged part of the bank, all the way to the channel bottom, and in some cases where undercutting has occurred, below the bottom. Otherwise the current may undermine the erosion control measures installed.

Be prepared to maintain your project. Inspect the project regularly, particularly after heavy rains and high flows, and make necessary repairs as soon as possible.

Re-establish streambank vegetation and trees using native plants.

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OTHER

MANAGEMENT OF UNDERGROUND STORAGE TANKS

Missouri has records of 37,580 underground storage tanks (USTs). The department has confirmed release of 5,716 tanks; with 4,446 cleanups completed.

Potential NPS Problems
These tanks pose a potential threat of nonpoint pollution to ground and surface waters of the state resulting from releases or leaks from these tanks, associated piping and their daily operations. Further, certain cleanup actions or cleanup technologies may produce discharges to waters of the state and exposure of contaminated soils during cleanup or tank closure poses a potential stormwater pollution threat.

To manage the potential nonpoint source pollution problem from these tanks, the Missouri Department of Natural Resources' Hazardous Waste Program (HWP) has developed and implemented a comprehensive set of preventative and corrective action regulations patterned after federal UST regulations. The HWP also maintains a database of tank sites (both registration of tanks and an inventory of sites with confirmed releases).

Further, the department's Water Pollution Control Program (WPCP) has, in coordination with HWP, developed a series of National Pollutant Discharge Elimination System (NPDES) permits to provide adequate control of nonpoint source pollution when a site has experienced a release and is undergoing either closure or cleanup.

Regulatory Authority
Federal UST regulations were promulgated under the authority of Subtitle I of the Resource Conservation and Recovery Act of 1976 as amended by the Solid Waste Amendments of 1984 and are published at Title 40, Code of Federal Regulations, Part 280. Missouri's regulations are authorized under Sections 319.100 through 319.139 of the Revised Statutes of Missouri and are published at Title 10 of the Code of State Regulations, Division 20, Chapters 10, 11 and 13.

These regulations provide the basis for early detection, reporting, investigation and cleanup of releases, prevention of future releases and financial responsibility requirements for UST cleanups.

A Petroleum Storage Tank Insurance Fund has been established which provides tank owners and operators an option for obtaining insurance coverage to meet their financial responsibility obligation as well as providing a program of remedial coverage for past releases at both current and former petroleum tank sites. Under the remedial program offered by this Fund, investigations and cleanups at these sites have been proceeding.

The agency responsible for implementing the environmental regulations is the HWP. Within the HWP, primary administrative responsibility is assigned to the HWP's Tanks Section, with compliance and enforcement actions handled by the Enforcement Section. The department's

five (5) DEQ Regional Offices, the Environmental Services Program and the Geological Survey & Resource Assessment Division handle field activities. These activities are funded by the federal Leaking Underground Storage Tank Trust Fund as well as by state fees for UST registration and by the state's Petroleum Storage Tank Insurance Fund.

HWP coordinates with WPCP on NPDES permit requirements at these sites. Specific site cleanup proposals (corrective action plans or CAPs) are required to demonstrate compliance by either obtaining an individual NPDES permit or by demonstrating that no permit is required. To streamline permitting, the WPCP, in coordination with HWP, has developed several general permits.

General permit #MO-G94 covers a range of activities associated with USTs that have the potential to produce a discharge of wastewater or stormwater.

General permit #MO-R401 provides for control of discharges from ex-situ, land treatment of petroleum contaminated soils. These land treatments include remediation techniques known as land farming and composting.

General permit #MO-R409 provides for control of in-situ corrective action technologies that are not performed in an aquifer. {Note: in-situ corrective action technologies which involve injection into an aquifer are subject to an individual NPDES permit through the underground injection control (UIC) program.}

Recommendations
The department continues to focus its efforts on implementation of the program as outlined above. In addition, Tanks Section staff are following developments in the field of fuel additives and risk-based corrective action (RBCA) policy.

Development and increased use of fuel additives to gasoline is being driven by Clean Air Act mandates. Ethyl alcohol, methyl alcohol, methyl tertiary butyl ether and tertiary amyl ether are all being used or considered for use as additives to gasoline. These additives may have the potential to change the characteristics of petroleum releases, including concerns over toxicity, mobility and the effectiveness of various cleanup technologies.

ATMOSPHERIC DEPOSITION

Progress Resulting From Clean Air Act Requirements

Provisions of the Clean Air Act require states to monitor ambient air quality for concentrations of “criteria” pollutants. These include, volatile organic compounds, nitrogen oxides (NOx), sulfur dioxide (SOx), Fine Particulates, Carbon Monoxide, and Lead (Pb). States are required to develop plans to address situations where monitored values exceed federal standards. Missouri has several areas that have historically exceeded the federal air quality standards. Emission controls are either in place or being planned for in these areas. Controlling these emissions can lead to direct reductions in atmospheric deposition.

Acid gases are a primary concern in atmospheric deposition. The Clean Air Act included requirements for the reduction of SOx and NOx emissions, the primary causes of acid rain. To achieve this goal at the lowest cost to society, the program employs both traditional and innovative, market-based approaches for controlling air pollution. In addition, the program encourages energy efficiency and pollution prevention.

Title IV of the Clean Air Act sets as its primary goal the reduction of annual SO_2 emissions by 10 million tons below 1980 levels. To achieve these reductions, the law requires a two-phase tightening of the restrictions placed on fossil fuel-fired power plants. Phase I began in 1995 and affects 263 units at 110 mostly coal-burning electric utility plants located in 21 eastern and midwestern states. An additional 182 units joined Phase I of the program as substitution or compensating units, bringing the total of Phase I affected units to 445. Emissions data indicate that 1995 SO_2 emissions at these units nationwide were reduced by almost 40% below their required level.

Phase II, which begins in the year 2000, tightens the annual emissions limits imposed on these large, higher emitting plants and also sets restrictions on smaller, cleaner plants fired by coal, oil, and gas, encompassing over 2,000 units in all. The program affects existing utility units serving generators with an output capacity of greater than 25 megawatts and all new utility units. The Act also calls for a 2 million ton reduction in NOx emissions by the year 2000. A significant portion of this reduction will be achieved by coal-fired utility boilers that will be required to install low NOx burner technologies to meet new emissions standards.

Atmospheric Chemistry

The National Atmospheric Deposition Program has two monitoring sites in Missouri, one in the southeast in Butler County and one in the center of the state in Boone County. Rainfall chemistry data from these two sites are similar, and show typical pH values of about 4.6, nitrate concentrations of about 1-mg/l and ammonia concentrations of about 0.3 mg/l. Since the low pH of rainfall is well buffered by the calcareous glacial till in northern Missouri, and limestone and dolomite rocks in most of southern Missouri, pH in surface and groundwater is usually not a problem. Instream and in-lake nitrate and ammonia levels are somewhat lower than concentrations in rainfall due to uptake by aquatic plants.

Acidification of Waters

The St. Francois Mountains area of southeast Missouri include substantial exposures of igneous rocks that provide little buffering of rainfall, but even in this area of the state, there is usually

enough calcareous rock to buffer stream and lake water. A survey of 35 streams in the St. Francois Mountains area by Missouri DNR in April, 1994, found only two streams, McKenzie and Trace Creeks with pH values less than 7.0. Subsequent data has led to the listing in the 1998 state 305(b) report of 5.5 miles of Trace Creek and 0.5 miles of McKenzie Creek as water quality impaired by low pH. A granite mine may aggravate the problem in McKenzie Creek.

Wylie and Jones (1991) evaluated 103 Missouri lakes for sensitivity to acidification using both total alkalinity and Calcite Saturation Index. Only four lakes, all of which were located in the St. Francois Mountains area, appeared to be acid sensitive by both standards. However, no lakes in the state, including these four, have low pH.

Mercury

Mercury is a toxic element released by both natural and man-made processes. Anthropogenic sources of mercury have increased significantly during the industrial revolution. In the US, coal-fired power plants, municipal and hospital waste incineration, Chlor-alkali plants and other sources emit 150 tons of mercury annually. This is only a small part of the global pool. It is now believed that mercury can circumvent the globe. Therefore, mercury emitted in China, or Japan may particulate in the US. Once mercury is deposited in rainwater, and enters lakes and streams, bacteria can change the inorganic mercury to methyl mercury. In this form, it is available to plants and animals. This form of mercury bioaccumulates up the food chain. Therefore, higher trophic levels are most impacted. Currently 44 states have fish advisories concerning mercury. Missouri has listed over 40 lakes and streams on their 303(d) list for mercury impairment.

The Missouri DNR is working nationally to control mercury emissions. In 2002, the department joined the Mercury Deposition Network and installed a wet deposition monitoring station in Mingo Wildlife area. The department has joined with other states to work towards stronger air emission legislation, and information sharing. Statewide activities that would lessen the amount of mercury in the environment include recycling, product bans, trade-outs, and dental amalgam traps.

APPENDIX F

Section 303(d) Waters

1998 303(d) List

CATEGORY 1
RECOMMENDED SECTION 303(d) WATERS REQUIRED TO HAVE TMDLS

Water	**County**	**Miles/Acres Affected*** **	**Pollutant**	**Source**
Streams/Rivers				
1529 Little Beaver Creek	Phelps	0.1	NFR	Rolla SW WWTP
1746 Big Bottom Creek	Ste. Genevieve	0.5	BOD, NFR	Lake Forest Subdivision
2916 Big Creek	Iron	4	Metals	Doe Run Lead smelter
1224 Big Otter Creek	Henry/St. Clair	1	pH	Otter Creek AML
2074 Big River	Jefferson	53	Lead	Old Lead Belt AML
2080 Big River	St. Francis	40	Lead, sediment	Old Lead Belt AML
2755 W. Fk. Black River	Reynolds	0.2	Nutrients	Doe Run W. Fork Mine
0811 E. Brush Creek	Moniteau	1	Nutrients	California N. WWTP
1370 Brush Creek	St. Clair	1	Inundation	Truman Dam
1592 Brushy Creek	Texas	0.2	NFR	Houston WWTP
0859 Brushy Fork	Pettis	1	BOD, NFR, NH_3N	Sedalia Central WWTP
3269, 3273 Buffalo Creek	McDonald	15.5	Nutrients	Livestock production
3118 Buffalo Ditch	Dunklin	2	BOD	Kennett WWTP
0709 Bynum Creek	Callaway	0.3	Sediment	Auxvasse Stone Quarry
9000 Cave Spring Branch	McDonald	0.2	Nutrients	Livestock/Simmons
0737 Cedar Creek	Callaway	2	pH, sulfate	Cedar Creek AML
		1	Sulfate	Cedar Creek AML
		1	Sulfate	Manacle, Cross-Mitchell AMLs
3203 Center Creek	Jasper	11	Zinc	Tristate AML
0640 Chariton River	Chariton	29	Fecal coliform	Unknown
3168 Chat Creek	Lawrence	2	Zinc	Aurora AML
3238 Clear Creek	Newton	1	BOD, NFR, NH_3N	Monett WWTP
3239 Clear Creek	Barry/Lawrence	2	BOD, NFR, NH_3N	Monett WWTP
0690 Dark Creek	Randolph	8	Sulfate	Crutchfield AML
0912 Davis Creek	Lafayette	2	BOD, Nutrients	Odessa SE WWTP
0510 Dog Creek	Daviess	0.2	Sediment	Traeger Quarry
1145 Dry Auglaize Creek	Laclede	1.5	BOD, NFR	Lebanon WWTP
2604 Eleven Point River	Howell	0.4	Chlorine	Willow Springs WWTP
3246 Elk River	McDonald	21.5	Nutrients	Livestock production
2168 Flat River Creek	St. Francis	5	Lead, sediment, zinc	Old Lead Belt AML
2860 Goose Creek	Madison	0.5	Nickel	Madison mine outflow
0883 Gabriel Creek	Morgan	1.1	BOD, NFR	Stover NW WWTP, Stover SW WWTP
1007 Hinkson Creek	Boone	6	Unspecified	Urban nonpoint source
1008 Hinkson Creek	Boone	5	Unspecified	Urban nonpoint source
1251 Honey Creek	Henry	3	Sulfate	Reliant AML
2582 Howell Creek	Howell	0.3	Chlorine	West Plains WWTP
3256 Indian Creek	McDonald/Newton	26	Nutrients	Livestock production

Water	County	Miles/Acres Affected***	Pollutant	Source
<u>Streams/Rivers</u> (cont.)				
3262, 3263 M. Indian Cr.	Newton	5.5	Nutrients	Livestock production
3260 N. Indian Creek	Newton	5	Nutrients	Livestock production
3259 S. Indian Creek	Newton	9	Nutrients	Livestock production
2681 Jacks Fork River	Shannon	5	Fecal coliform	Organic wastes
2347, 2362, 2365 James River	Greene/Stone/ Christian	58.5	Nutrients, unknown	Urban point & nonpoint source
1016 Kelley Branch	Boone	1	Habitat loss	ORV use Finger Lakes State Park
1438 Little Lindley Creek	Dallas	1	BOD, NFR	Buffalo WWTP
0427 E. Fk. Little Blue R.	Jackson	0.1	BOD, NFR	Independence MHP
0535 Long Creek	Caldwell	0.2	Sediment	Everett #6 Quarry
2814 Main Ditch	Butler	5	BOD, NFR	Poplar Bluff WWTP
0742 Manacle Creek	Callaway	2	pH, sulfate	Manacle Creek AML
1308 Marmaton River	Vernon	49.5	Not stated	Natural background
2787 McKenzie Creek	Wayne	0.5	pH	Gads Hill Quarry
1234 Monegaw Creek	St. Clair	3	Sulfate	Montee AML
0942 N. Moreau Creek	Moniteau	10	Susp. Algae	California S. WWTP
1300 Mound Branch	Bates	1	BOD	Butler WWTP
0856 L. Muddy Creek	Pettis	0.7	Temperature	Tyson's Foods Inc.
0855 Muddy Creek	Pettis	33	BOD	Sedalia Central WWTP
3490 Trib. L. Muddy Creek	Pettis	0.4	Temperature, NH_3N	Tyson's Foods Inc.
1305 Mulberry Creek	Bates	8	Sulfate	Mulberry Creek AML
3652 Little Osage River	Vernon	16	Not stated	Natural background
1310 Little Osage River	Vernon	6.3	Not stated	Natural background
1031 Osage River	Miller/Cole	0.4	Habitat loss	Capital Sand&Gravel, Osage S&G
3268 Patterson Creek	McDonald	2	Nutrients	Livestock production
2373 Pearson Creek	Greene	1.5	Unknown toxicity	Unknown
2614 Piney Creek	Oregon	0.1	Chlorine	Alton WWTP
1714 Rock Creek	Jefferson	2	BOD, NH_3N	2 WWTPs
1014 Rocky Fork	Boone	0.5	Sediment	Finger Lakes AML
0278 Rush Cr.	Platte	0.2	BOD, NFR	Platte Co. Sewer Dist. #7 WWTP
1381 L. Sac River	Greene/Polk	27	Fecal coliform	Springfield NW WWTP
2859 Saline Creek	Madison	0.5	Nickel	Madison mine outflow
2190 Saline Creek	Jefferson	2	BOD, NH_3N	Ron Rog WWTP, Hwy 141 WWTP
0091 Salt River	Ralls	29	Manganese,Iron,Low D.O.	Cannon Dam
0103 Salt River	Ralls/Pike	10	Low D.O., Manganese	Cannon Dam
1319 Second Nicholson Creek	Barton	3	Sulfate	Many AML areas
2170 Shaw Branch	St. Francis	2	Sediment	Federal AML
2120 Shibboleth Creek	Washington	0.5	Sediment	Barite tailings pond
3230 Shoal Creek	Barry/Newton	13.5	Fecal coliform	Unknown ag. sources
0400 W. Fk. Sni-a-Bar Cr.	Jackson	0.2	BOD, NFR	Lake Lotawana WWTP
2835 St. Francis River	St. Francis	3	NH_3N, BOD	Farmington W. WWTP
1361 Stockton Branch	Cedar	2	Susp. Algae	Stockton WWTP
0959 Straight Fork	Morgan	2	Susp. Algae	Versailles WWTP
3250 B. Sugar Creek	McDonald/Barry	31	Nutrients	Livestock production

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers (cont.)				
3249 L. Sugar Creek	McDonald	11	Nutrients	Livestock production
0686 Sugar Creek	Randolph	1	pH	Huntsville AML
		0.5	pH	Calfee Mine Flow
1282 E. Fk. Tebo Creek	Henry	1	pH	Triple Tipple AML
1284 M. Fk. Tebo Creek	Henry	5.5	Sulfate	Newcastle Tipple AML,
			other AML	
1288 M. Fk. Tebo Creek	Henry	2	pH, sulfate	Newcastle Tipple AML
		1.5	Sulfate	Newcastle Tipple AML
1292 W. Fk. Tebo Creek	Henry	7	Sulfate	Spargler AML
2850 Trace Creek	Madison	4.2	pH	Unknown
		1.3	pH	Unknown, sawdust pile
leachate				
1211 Trib. Barker's Creek	Henry	0.3	pH, sulfate	Grey AML
1225 Trib. Big Otter Creek	Henry/St. Clair	1	pH	Otter Creek AML
2128 Trib. Pond Creek	Washington	0.5	Sediment	Barite tailings pond
3217 Turkey Creek	Jasper	5	Zinc	Duenweg AML
3216 Turkey Creek	Jasper	3.5	Zinc	Duenweg AML
		4	PCP	Joplin Turkey Crk WWTP
		4	BOD, NFR	Joplin Turkey Crk WWTP
3282 Turkey Creek	St. Francis	1.5	BOD, NFR	Bonne Terre WWTP
2864 Village Creek	Madison	0.5	Sediment	Mine la Motte AML
1505 Whetstone Creek	Wright	2	BOD	2 Mountain Grove WWTPs
2375 Wilson Creek	Greene/Christian	18	Unknown toxicity	Urban nonpoint source
Lakes				
7119 Cameron Lower Lake	DeKalb	96	Atrazine	Corn, sorghum
production				
7120 Cameron Lake #1	DeKalb	25	Atrazine	Corn, sorghum
production				
7121 Cameron Lake #2	DeKalb	35	Atrazine	Corn, sorghum
production				
7237 Fellows Lake	Greene	820	Nutrients	Ag/suburban nonpoint
source				
7124 Hamilton Lake	Caldwell	80	Cyanazine	Corn, sorghum
production				
7190 Higginsville S. Lake	Lafayette	223	Atrazine	Corn, sorghum
production				
7022 LaBelle Lake #1	Lewis	17	Atrazine	Corn, sorghum
production				
7023 LaBelle Lake #2	Lewis	112	Atrazine	Corn, sorghum
production				
7205 Lake of the Ozarks	Benton	50	Low D.O.	Truman Dam
			Gas supersaturation	Truman Dam
			Fish trauma	Truman Dam
7314 Lake Taneycomo	Taney	1,730	Low D.O.	Table Rock Dam
7356 Lamar Lake	Barton	180	Nutrients	Ag nonpoint source

7033 Mark Twain Lake	Ralls	18,600	Atrazine	Corn, sorghum production
7236 McDaniel Lake	Greene	300	Nutrients	Ag/suburban nonpoint source
7031 Monroe City Route J Lake	Ralls	94	Atrazine	Corn, sorghum production
			Cyanazine	Corn, sorghum production
7187 Spring Fork Lake	Pettis	178	Algae	Ag nonpoint source
7077 Smithville Lake	Clay	7,190	Atrazine	Corn, sorghum production
7207 HS Truman Lake	Bates/Benton	55,600	Manganese	Natural
7032 Vandalia Lake	Pike	37	Atrazine	Corn, sorghum production

CATEGORY 2
RECOMMENDED SECTION 303(d) WATERS REQUIRED TO HAVE ADDITIONAL MONITORING PRIOR TO TMDL DEVELOPMENT

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers				
1250 Big Cr.	Cass/Henry	49	Sediment*	Ag nonpoint source
0449 W. Fk. Big Cr.	Harrison	18	Sediment	Ag nonpoint source
0436 Big Muddy Cr.	Daviess	8	Sediment *+	Ag nonpoint source
0653 Blackbird Cr.	Putnam/Adair	10.5	Sediment+	Ag nonpoint source
0921 S. Fk. Blackwater	Johnson	5	Sediment*	Ag nonpoint source
1336 Clear Cr.	Vernon	18	Sediment+	Ag nonpoint source
0372 E. Fk. Crooked Cr.	Ray	14	Sediment	Ag nonpoint source
1325 L. Drywood Cr.	Vernon	17	Sediment	Ag nonpoint source
0189 Elkhorn Cr.	Montgomery	0.5	Sediment	Ag nonpoint source
0056 N. Fabius R.	Marion/Schuyler	82	Sediment	Ag nonpoint source
0865 Flat Cr.	Pettis	20	Sediment+	Ag nonpoint source
0457 E. Fk. Grand R.	Worth/Gentry	25	Sediment	Ag nonpoint source
0468 M. Fk. Grand R.	Worth/Gentry	25	Sediment+	Ag nonpoint source
0502 Grindstone Cr.	Clinton/DeKalb	16	Sediment	Ag nonpoint source
0337 Honey Cr.	Nodaway	8.5	Sediment	Ag nonpoint source
0554 Honey Cr.	Livingston	23	Sediment	Ag nonpoint source
0212 Indian Camp Cr.	Warren	5	Sediment	Ag nonpoint source
0875 Lake Cr.	Pettis	15	Sediment	Ag nonpoint source
3105 Lat.#2 Main Ditch	Stoddard	11.5	Sediment *	Ag nonpoint source
0606 Locust Cr.	Putnam/Chariton	84	Sediment	Ag nonpoint source
0612 W. Fk. Locust Cr.	Sullivan/Linn	17	Sediment+	Ag nonpoint source
0339 Long Branch	Nodaway	6	Sediment	Ag nonpoint source
0508 Marrowbone Cr.	Daviess	11	Sediment	Ag nonpoint source
0619 E. Fk. Medicine Cr.	Putnam/Grundy	36	Sediment *+	Ag nonpoint source
0623 L. Medicine Cr.	Mercer/Grundy	40	Sediment *+	Ag nonpoint source
1299 Miami Cr.	Bates	18	Sediment	Ag nonpoint source
0159 Mill Creek	Lincoln	4	Sediment	Ag nonpoint source
0001 Mississippi River	Clark-St. Charles	165	Habitat loss	Channelization
1707 Mississippi River	St. Charles-Mississippi	200.5	Habitat loss	Channelization
3152 Mississippi River	Mississippi-Pemiscot	124.5	Habitat loss	Channelization
0226 Missouri River	Atchison-Jackson	179	Habitat loss	Channelization
0356 Missouri River	Jackson-Chariton	125	Habitat loss	Channelization
0701 Missouri River	Chariton-Gasconade	129	Habitat loss	Channelization
1604 Missouri River	Gasconade-St. Charles	100	Habitat loss	Channelization
0345 White Cloud Cr.	Andrew/Nodaway	11	Sediment	Ag nonpoint source
0674 Mussel Fork	Sullivan/Macon	29	Sediment+	Ag nonpoint source
1175 W. Fk. Niangua R.	Webster	0.5	BOD,NFR	Marshfield WWTP
0081 North R.	Marion/Shelby	40	Sediment	Ag nonpoint source
3041 Old Ch. Little R.	New Madrid	20	Sediment *	Ag nonpoint source
		3.5	Sediment	Ag nonpoint source
1444 Piper Cr.	Polk	0.5	NFR	Bolivar WWTP
0327 3rd Fk. Platte R.	Gentry/Buchanan	31.5	Sediment	Ag nonpoint source
0121 M. Fk. Salt R.	Monroe/Macon	49	Sediment	Ag nonpoint source
3134 Spillway Ditch	Mississippi/NewMadrid	13.5	Sediment*	Ag nonpoint source
0657 Spring Cr.	Sullivan/Adair	18	Sediment+	Ag nonpoint source

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers (cont.)				
1870 Spring Cr.	Dent	0.3	BOD, NFR	Salem WWTP
3188 N. Fk. Spring R.	Dade/Jasper	51.5	Sediment	Ag nonpoint source
0710 Stinson Cr.	Callaway	0.5	BOD, NH_3N, NFR	Fulton WWTP
0248 L. Tarkio Cr.	Holt	17.5	Sediment+	Ag nonpoint source
0073 Troublesome Cr.	Marion	3.5	Sediment+	Ag nonpoint source
1339 Walnut Cr.	Cedar	1.0	BOD,NFR	El Dorado Spgs. WWTP
0050 S. Wyaconda R.	Clark/Scotland	9.0	Sediment+	Ag nonpoint source
Lakes				
7171 Long Branch Lake	Macon	2430	Cyanazine	Corn, sorghum production
7009 Wyaconda Lake	Clark	8	Atrazine	Corn, sorghum production

* stream has significant amounts of channelization
+ large Concentrated Animal Feeding Operations in this watershed

CATEGORY 3
RECOMMENDED SECTION 303(d) WATERS REQUIRED TO HAVE USE ATTAINABILITY ANALYSES OR TMDL DEVELOPMENT

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers				
0417 Blue River	Jackson	4	Chlordane	Urban nonpoint sources
0418 Blue River	Jackson	9	Chlordane	Urban nonpoint sources
0419 Blue River	Jackson	9	Chlordane	Urban nonpoint sources
0421 Blue River	Jackson	2	Chlordane	Urban nonpoint sources
0037 Fox River	Clark	12	Sediment	Ag nonpoint source
0046 Wyaconda River	Lewis	8	Manganese	Natural
0063 M. Fabius River	Lewis	57	Manganese	Natural
Lakes				
7255 Creve Coeur Lake	St. Louis	300	Chlordane	Urban nonpoint source
7054 Lake St. Louis	St. Charles	525	Chlordane	Urban nonpoint source
7211 Pleasant Hill Lake	Cass	115	Chlordane	Unknown
7207 Truman Lake	Bates-Benton	55,600	Manganese	Natural

Notes:

***** Units are in miles for streams and surface acres for lakes.**

Abbreviations:

AML	Abandoned mined land
BOD	Biological oxygen demand
D.O.	Dissolved oxygen
NFR	Non-filterable residue
NH_3N	Ammonia
pH	Acidic conditions
PCP	Pentachlorophenol
WWTP	Wastewater treatment plant

APPENDIX G

Streams Designated for Cold Water Fisheries

Streams Designated for Cool Water Fisheries

Outstanding National Resource Waters

Outstanding State Resource Waters

Table 20. WATER BODIES DESIGNATED FOR COLDWATER FISHERY

Water body	Miles/Acres		From	To	County(ies)
Barren Fork	2.0	mi.	Mouth	20, 31N, 04W	Shannon
Bee Creek	1.6	mi.	Mouth	17, 23N, 21W	Taney
Bender Creek	0.7	mi.	Mouth	10, 31N, 09W	Texas
Bennett Springs Creek	2.0	mi.	Mouth	Bennett Springs	Laclede
Blue Springs Creek	4.0	mi.	Mouth	02, 39N, 03W	Crawford
Bryant Creek	1.0	mi.	03, 23N, 12W	34, 24N, 12W	Ozark
Bryant Creek	6.0	mi.	19, 27N, 14W	08, 27N, 15W	Douglas
Buffalo Creek	10.0	mi.	State line	05, 23N, 33W	McDonald
Bull Creek	5.0	mi.	Mouth	34, 24N, 21W	Taney
Bull Shoals Lake	9000.0	ac.	21 & 35, 20N, 15W	---	Ozark
Capps Creek	4.0	mi.	Mouth	17, 25N, 28W	Newton-Barry
Cedar Creek	1.0	mi.	21, 26N, 32W	28, 26N, 32W	Newton
Center Creek	3.0	mi.	23, 27N, 29W	17, 27N, 28W	Lawrence
Chesapeake Creek	3.0	mi.	Mouth	29, 28N, 25W	Lawrence
Crane Creek	15.0	mi.	08, 25N, 23W	23, 26N, 25W	Stone-Lawrence
Current River	19.0	mi.	24, 31N, 06W	Montauk Spring	Shannon-Dent
Dogwood Creek	2.3	mi.	Mouth	State line	Stone
Dry Creek	4.0	mi.	Mouth	14, 37N, 03W	Crawford
Eleven Point River	33.5	mi.	State line	36, 25N, 04W	Oregon
Flat Creek	3.0	mi.	09, 23N, 27W	21, 23N, 27W	Barry
Goose Creek	4.0	mi.	Mouth	10, 28N, 25W	Lawrence
Greer Spring Branch	1.0	mi.	Mouth	36, 25N, 04W	Oregon
Hickory Creek	4.5	mi.	13, 25N, 31W	28, 25N, 31W	Newton
Hobbs Hollow	2.7	mi.	Mouth	State line	Stone
Horse Creek	2.2	mi.	Mouth	23, 35N, 8W	Dent
Hunter Creek	5.0	mi.	22, 26N, 15W	20, 26N, 14W	Douglas
Hurricane Creek	1.5	mi.	Mouth	30, 24N, 12W	Ozark
Hurricane Creek	3.2	mi.	Mouth	22, 25N, 03W	Oregon
Indian Creek	20	mi.	Mouth	36, 39N, 01W	Franklin-Washington
Indian Creek	1.4	mi.	Mouth	17, 21N, 23W	Stone
Johnson Creek	3.0	mi.	Mouth	36, 29N, 26W	Lawrence
Joyce Creek	1.0	mi.	17, 24N, 28W	16, 24N, 28W	Barry
L. Flat Creek	3.5	mi.	Mouth	25, 25N, 27W	Barry
L. Piney Creek	15.0	mi.	25, 37N, 09W	04, 35N, 08W	Phelps
L. Piney Creek	4.0	mi.	04, 35N, 08W	21, 35N, 08W	Phelps
L. Sinking Creek	2.2	mi.	Mouth	33, 32N, 04W	Dent
Lyman Creek	1.0	mi.	Mouth	30, 40N, 03W	Crawford
Maramec Spring Branch	1.0	mi.	Mouth	01, 37N, 06W	Phelps
Meramec River	10.0	mi.	22, 38N, 05W	Hwy. 8	Crawford
Mill Creek	1.5	mi.	Mouth	09, 36N, 18W	Dallas
Mill Creek	5.0	mi.	29, 37N, 09W	Yelton Spring	Phelps
Mill Creek	1.5	mi.	Mouth	11, 40N, 08W	Maries
N. Fork White River	23.0	mi.	09, 22N, 12W	34, 25N, 11W	Ozark
Niangua River	6.0	mi.	11, 35N, 18W	Bennett Sp. Creek	Dallas

Water body	Miles/Acres		From	To	County(ies)
Parker Hollow	2.0	mi.	Mouth	20, 32N, 06W	Dent
Roaring River	7.0	mi.	Mouth	34, 22N, 27W	Barry
Roark Creek	3.0	mi.	Mouth	36, 23N, 22W	Taney
Roubidoux Creek	4.0	mi.	Mouth	25, 36N, 12W	Pulaski
S. Indian Creek	9.0	mi.	24, 24N, 31W	01, 23N, 30W	Newton-McDonald
Schafer Spring Creek	2.0	mi.	Mouth	20, 32N, 06W	Dent
Shoal Creek	1.0	mi.	Mouth	18, 41N, 17W	Morgan
Shoal Creek	7.0	mi.	09, 25N, 29W	16, 22N, 21W	Newton
Spring Branch	1.0	mi.	Mouth	19, 41N, 17W	Morgan
Spring Creek	6.5	mi.	Mouth	31, 35N, 09W	Phelps
Spring Creek	2.5	mi.	Mouth	04, 41N, 02W	Franklin
Spring Creek	5.5	mi.	Mouth	12, 26N, 24W	Stone
Spring Creek	6.0	mi.	Mouth	06, 24N, 13W	Douglas-Ozark
Spring Creek	2.5	mi.	Mouth	26, 25N, 11W	Douglas
Spring Creek	5.0	mi.	Mouth	14, 23N, 11W	Ozark
Spring Creek	4.0	mi.	Mouth	30, 25N, 04W	Oregon
Spring Hollow	10.0	mi.	Bennett Springs	27, 34N, 17W	Laclede
Spring River	11.2	mi.	13, 27N, 27W	20, 26N, 26W	Lawrence
Stokes Lake #1 (Arrowhead Lakes)	60	ac.	18, 23N, 08W	---	Howell
Stokes Lake #2 (Arrowhead Lakes)	80	ac.	11, 23N, 08W	---	Howell
Stone Mill Spring Branch	0.2	mi.	Mouth	Spring	Pulaski
Taneycomo, Lake	1730	ac.	08, 23N, 20W	---	Taney
Terrell Creek	2.0	mi.	Mouth	02, 27N, 23W	Christian
Tory Creek	2.5	mi.	Mouth	27, 26N, 22W	Stone-Christian
Turkey Creek	2.0	mi.	Mouth	16, 22N, 21W	Taney
Turkey Creek	1.0	mi.	Mouth	17, 23N, 15W	Ozark
Turnback Creek	14.0	mi.	35, 30N, 26W	24, 28N, 25W	Dade-Lawrence
Warm Fork Spring River	3.0	mi.	6, 22N, 5W	30, 23N, 05W	Oregon
Whittenburg Creek	2.5	mi.	Mouth	Hwy. 8	Crawford
Williams Creek	1.0	mi.	Mouth	28, 28N, 27W	Lawrence
Woods Fork Bull Creek	1.0	mi.	15, 25N, 21W	15, 25N, 21W	Christian
Yadkin Creek	3.0	mi.	Mouth	09, 37N, 04W	Crawford
Yankee Branch	1.0	mi.	Mouth	10, 36N, 04W	Crawford

Table 21. WATER BODIES DESIGNATED FOR COOL WATER FISHERY

WATER BODY	CLASS	MILES	FROM	TO	COUNTY	COUNTY 2
Bank Br.	C	5.0	Mouth	35, 37N, 17W	Camden	
Barren Fk.	P	6.0	Mouth	30, 39N, 13W	Miller	
Beaver Cr.	P	22.0	Mouth	29, 30N, 12W	Wright	Texas
Beaver Cr.	P	44.5	Mouth	23, 27N, 17W	Taney	Douglas
Bee Fk.	C	8.5	Mouth	30, 32N, 01W	Reynolds	
Big Barren Cr.	C	19.0	Mouth	32, 26N, 02W	Ripley	Carter
Big Buffalo Cr.	P	6.0	Mouth	06, 41N, 19W	Benton	Morgan
Big Buffalo Cr.	C	2.5	06, 41N, 19W	12, 42N, 20W	Morgan	
Big Cr.	P	32.0	Mouth	23, 33N, 03E	Wayne	Iron
Big Cr.	C	27.0	Mouth	05, 29N, 08W	Shannon	Texas
Big Piney R.	P	99.0	Mouth	16, 29N, 10W	Pulaski	Texas
Big R.	P	53.0	Mouth	Sur 3166, 40N, 03E	Jefferson	
Big Sugar Cr.	P	31.0	34, 22N, 32W	27, 21N, 29W	McDonald	Barry
Black R.	P	35.0	16, 25N, 06E	Clearwater Dam	Butler	Wayne
Black R.	P	26.0	07, 29N, 03E	17, 32N, 02E	Reynolds	
Black R.	P	45.0	State Line	16, 25N, 06E	Butler	
Bourbeuse R.	P	132.0	Mouth	04, 39N, 06W	Franklin	Phelps
Bourbeuse R.	C	9.0	04, 39N, 06W	12, 38N, 07W	Phelps	
Brush Cr.	P	11.5	Mouth	31, 36N, 24W	St. Clair	Polk
Brushy Fk.	C	5.0	Mouth	12, 39N, 14W	Miller	
Bryant Cr.	P	43.0	34, 24N, 12W	17, 27N, 15W	Ozark	Douglas
Bryant Cr.	P	13.5	05, 22N, 12W	03, 23N, 12W	Ozark	Douglas
Buffalo Cr.	P	5.5	05, 23N, 33W	14, 24N, 33W	Newton	
Buffalo Cr.	P	10.0	State Line	05, 23N, 33W	McDonald	
Bull Cr.	P	17.5	34, 24N, 21W	33, 26N, 20W	Taney	Christian
Butler Cr.	P	3.5	Mouth	State Line	McDonald	
Cane Cr.	P	23.0	36, 23N, 05E	05, 25N, 05E	Butler	
Cane Cr.	C	15.0	05, 25N, 05E	15, 26N, 03E	Butler	Carter
Cane Cr.	C	3.0	Mouth	28, 23N, 18W	Taney	
Castor R.	P	59.5	29, 29N, 09E	19,34N,8E	Bollinger	Madison
Center Cr.	P	26.0	14, 28N, 34W	34, 28N, 31W	Jasper	
Clark Cr.	P	10.0	Mouth	20, 29N, 04E	Wayne	
Cole Camp Cr.	P	16.4	Mouth	07, 42N, 21W	Benton	
Courtois Cr.	P	30.0	Mouth	17, 35N, 01W	Crawford	Washington
Courtois Cr.	C	1.5	17, 35N, 01W	21, 35N, 01W	Washington	Iron
Crooked Cr.	P	18.0	Mouth	36, 35N, 04W	Crawford	Dent
Crooked Cr.	P	3.5	Mouth	33, 35N, 02W	Crawford	
Current R.	P	118.0	State Line	24, 31N, 06W	Ripley	Shannon
Deer Cr.	P	11.7	Mouth	21, 39N, 20W	Benton	
Eleven Point R.	P	19.0	36, 25N, 04W	23, 25N, 06W	Oregon	
Eleven Point R.	P	21.0	State Line	18, 24N, 02W	Oregon	
Eleven Point R.	C	34.0	23, 25N, 06W	33, 27N, 09W	Oregon	Howell
Elk R.	P	21.5	State Line	34, 22N, 32W	McDonald	
Finley Cr.	P	44.0	Mouth	19, 28N, 16W	Stone	Webster
Flat Cr.	P	7.5	21, 23N, 27W	23, 22N, 28W	Barry	
Flat Cr.	P	39.0	28, 24N, 24W	09, 23N, 27W	Stone	Barry

WATER BODY	CLASS	MILES	FROM	TO	COUNTY	COUNTY 2
Fourche Cr.	P	14.0	State Line	15, 23N, 01W	Ripley	
Gasconade R.	P	249.0	Mouth	06, 29N, 14W	Gasconade	Wright
Greasy Cr.	P	4.0	Mouth	31, 34N, 19W	Dallas	
Greasy Cr.	C	10.5	31, 34N, 19W	11, 32N, 20W	Dallas	
Heaths Cr.	P	13.0	Mouth	27, 48N, 22W	Cooper	Pettis
Heaths Cr.	C	10.0	27, 48N, 22W	17, 47N, 22W	Pettis	
Hog Cr.	P	4.5	Mouth	06, 29N, 09W	Texas	
Hogles Cr.	P	20.7	Mouth	32, 38N, 23W	Benton	Hickory
Hogles Cr.	C	7.4	32, 38N, 23W	34, 37N, 23W	Hickory	
Huzzah Cr.	P	34.0	Mouth	01, 34N, 03W	Crawford	Dent
Indian Cr.	P	7.2	Mouth	21, 42N, 20W	Benton	
Indian Cr.	P	26.0	Mouth	24, 24N, 31W	McDonald	Newton
Indian Cr.	C	3.0	36, 39N, 01W	08, 38N, 01E	Washington	
Jacks Fk.	P	39.0	Mouth	29, 28N, 07W	Shannon	Texas
James R.	P	28.0	10, 24N, 22W	08, 26N, 22W	Stone	
James R.	P	26.0	08, 26N, 22W	Lake Springfield Dam	Stone	Greene
James R.	P	35.0	Hwy. 65	24, 29N, 17W	Greene	Webster
Jones Cr.	P	7.0	Mouth	30, 27N, 30W	Jasper	Newton
L. Black R.	P	16.0	31, 24N, 05E	09, 24N, 03E	Butler	Ripley
L. Maries Cr.	P	7.0	Mouth	24, 42N, 11W	Osage	
L. N. Fk. White R.	P	5.0	Mouth	36, 24N, 16W	Ozark	
L. N. Fk. White R.	C	6.0	36, 24N, 16W	03, 24N, 16W	Ozark	
L. Niangua R.	P	43.0	Mouth	26, 36N, 19W	Camden	Dallas
L. Piney Cr.	P	6.0	Mouth	25, 37N, 09W	Phelps	
L. Pomme de Terre R.	C	7.0	Mouth	22, 38N, 23W	Benton	Hickory
L. Sac R.	P	29.0	Mouth	McDaniel Lake Dam	Polk	Greene
L. St. Francis R.	P	27.7	Mouth	32, 35N, 07E	Madison	St. Francois
L. Sugar Cr.	P	11.0	34, 22N, 32W	State Line	McDonald	
L. Tavern Cr.	C	4.0	Mouth	34, 42N, 13W	Miller	Cole
L. Weaubleau Cr.	P	5.7	Mouth	09, 36N, 23W	St. Clair	Hickory
Lake Cr.	P	4.3	Mouth	12, 44N, 20W	Pettis	Morgan
Lake Cr.	C	9.7	12, 44N, 20W	17, 43N, 20W	Pettis	Benton
Limestone Cr.	P	7.0	Mouth	24, 30N, 27W	Dade	
Lost Cr.	P	7.0	Mouth	15, 46N, 03W	Warren	
Lost Cr.	P	8.5	State Line	14, 25N, 33W	Newton	
Mahans Cr.	P	4.0	Mouth	09, 28N, 04W	Shannon	
Marble Cr.	P	14.5	Mouth	29, 33N, 04E	Madison	Iron
Maries R.	P	41.5	Mouth	24, 40N, 10W	Osage	Maries
Meramec R.	P	10.0	22, 38N, 05W	Hwy. 8	Crawford	
Meramec R.	P	37.0	Big R.	Meramec State Park	Jefferson	Franklin
Meramec R.	P	26.0	Hwy. 141	Big R.	St. Louis	Jefferson
Meramec R.	P	35.0	Hwy. 8	Hwy. 72	Crawford	Dent
Meramec R.	P	75.0	Meramec State Park	22, 38N, 05W	Franklin	Crawford
Meramec R.	C	4.0	Hwy. 72	33, 34N, 04W	Dent	
Middle Fk. Black R.	P	15.0	Mouth	24, 34N, 01W	Reynolds	Iron
Middle Fk. Black R.	C	1.0	24, 34N, 01W	13, 34N, 01W	Iron	
Mill Cr.	P	6.2	Mouth	09, 37N, 21W	Hickory	
Mill Cr.	C	2.8	09, 37N, 21W	15, 37N, 21W	Hickory	

WATER BODY	CLASS	MILES	FROM	TO	COUNTY	COUNTY 2
Mineral Fk.	P	15.0	Mouth	07, 38N, 02E	Washington	
N. Fk. White R.	P	28.0	34, 25N, 11W	17, 27N, 11W	Douglas	
Niangua R.	P	6.0	11, 35N, 18W	Bennett Spring Cr.	Dallas	
Niangua R.	P	51.0	Bennett Spring Cr.	33, 32N, 18W	Dallas	Webster
Niangua R.	P	24.0	Dallas County Line	11, 35N, 18W	Dallas	
Osage Fk.	P	69.0	Mouth	26, 30N, 17W	Laclede	Webster
Peno Cr.	C	11.0	Mouth	32, 54N, 03W	Pike	
Pike Cr.	P	3.0	Mouth	34, 27N, 01W	Carter	
Pomme de Terre R.	P	21.0	Mouth	Pomme de Terre Dam	Hickory	
Roubidoux Cr.	P	18.0	11, 34N, 12W	04, 31N, 11W	Pulaski	Texas
Roubidoux Cr.	C	20.0	25, 36N, 12W	11, 34N, 12W	Pulaski	
S. Fk. Buffalo Cr.	P	2.0	20, 24N, 01E	30, 24N, 01E	Ripley	
S. Fk. Buffalo Cr.	C	4.0	30, 24N, 01E	34, 24N, 01W	Ripley	
S. Fk. Saline Cr.	P	20.5	Mouth	28, 35N, 09E	Perry	
Saline Cr.	P	12.0	13, 36N, 09E	16, 35N, 08E	Ste. Genevieve	
Shoal Cr.	P	13.5	Capps Cr.	12, 23N, 28W	Newton	Barry
Shoal Cr.	P	43.5	State Line	10, 25N, 29W	Newton	
Sinking Cr.	P	21.0	Mouth	08, 32N, 03W	Shannon	Dent
Spring R.	P	0.5	22, 28N, 34W	15, 28N, 34W	Jasper	
Spring R.	P	58.5	State Line	20, 28N, 27W	Jasper	Lawrence
St. Francis R.	P	86.0	Sur 727, 28N, 05E	16, 35N, 04E	Wayne	St. Francois
Starks Cr.	P	11.5	Mouth	12, 37N, 21W	Hickory	
Starks Cr.	C	3.0	12, 37N, 21W	31, 37N, 20W	Hickory	
Stouts Cr.	P	9.0	Mouth	33, 24N, 04E	Madison	Iron
Strother Cr.	P	7.0	Mouth	33, 34N, 01W	Reynolds	Iron
Sugar Cr.	P	8.8	Mouth	23, 41N, 11W	Miller	Maries
Swan Cr.	P	29.5	Mouth	04, 26N, 18W	Taney	Christian
Tavern Cr.	P	37.0	Mouth	05, 38N, 12W	Miller	
Tavern Cr.	C	8.0	05, 38N, 12W	12, 37N, 13W	Miller	Pulaski
Terre Bleue Cr.	P	4.5	Mouth	Sur 2107, 37N, 05E	St. Francois	
Trace Cr.	P	4.0	Mouth	04, 30N, 08E	Wayne	Bollinger
Turkey Cr.	P	16.2	Mouth	05, 38N, 21W	Benton	
Twelve Mile Cr.	P	7.5	Mouth	12, 31N, 06E	Madison	
Twelve Mile Cr.	C	6.0	12, 31N, 06E	17, 32N, 07E	Madison	
W. Fk. Black R.	P	31.7	Mouth	25, 33N, 03W	Reynolds	
W. Fk. Fourche Cr.	P	9.0	Mouth	15, 22N, 01W	Ripley	
W. Fk. Fourche Cr.	C	2.0	15, 22N, 01W	Hwy. 142	Ripley	
Whetstone Cr.	P	13.0	Mouth	21, 29N, 13W	Wright	
Whitewater R.	P	14.0	30, 33N, 11E	29, 34N, 09E	Bollinger	Perry
Williams Cr.	P	5.0	Mouth	11, 42N, 21W	Benton	

Table 22. OUTSTANDING NATIONAL RESOURCE WATERS

Stream	Location
Current River	Headwaters to Northern Ripley Co. Line
Jacks Fork River	Headwaters to Mouth
Eleven Point River	Headwaters to Hwy. 142

Table 23. OUTSTANDING STATE RESOURCE WATERS

Waterbody	Miles/Acres		Location	County(ies)
Baker Branch	4.0	mi.	Taberville Prairie	St. Clair
Bass Creek	1.0	mi.	Three Creek Conservation Area	Boone
Big Buffalo Creek	1.5	mi.	Big Buffalo Creek Conservation Area	Benton-Morgan
Big Creek	5.3	mi.	Sam A. Baker State Park	Wayne
Big Sugar Creek	7.0	mi.	Cuivre River State Park	Lincoln
Big Lake Marsh	150.0	ac.	Big Lake State Park	Holt
Blue Springs Creek	4.0	mi.	Blue Spring Creek Conservation Area	Crawford
Bonne Femme Creek	2.0	mi.	Three Creeks Conservation Area	Boone
Bull Creek	8.0	mi.	Mark Twain National Forest	Christian
Brush Creek	0.7	mi.	Bonanza Conservation Area	Caldwell
Bryant Creek	1.5	mi.	Bryant Creek Natural Area in Rippee Conservation Area	Ozark-Douglas
Cathedral Cave Branch	5.0	mi.	Onondaga Cave State Park	Crawford
Chariton River	9.8	mi.	Rebels Cove Conservation Area	Putnam-Schuyler
Chloe Lowry Marsh	40.0	ac.	Chloe Lowry Marsh Conservation Area	Mercer
Coakley Hollow	1.5	mi.	Lake of the Ozarks State Park	Camden
Coonville Creek	2.0	mi.	St. Francois State Park	St. Francois
Courtois Creek	12.0	mi.	Mouth to Hwy. 8	Crawford
Crabapple Creek	1.0	mi.	Bonanza Conservation Area	Caldwell
Devils Ice Box Cave Branch	1.5	mi.	Rock Bridge State Park	Boone
East Fork Black River	3.0	mi.	Johnson’s Shut-Ins State Park	Reynolds
First Nicholson Creek (East Drywood Creek)	2.0	mi.	Prairie State Park	Barton
Gan’s Creek	3.0	mi.	Rock Bridge State Park	Boone
Huzzah Creek	6.0	mi.	Mouth to Hwy 8.	Crawford
Indian Creek	17.5	mi.	Mark Twain National Forest	Douglas-Howell
Ketchum Hollow	1.5	mi.	Roaring River State Park	Barry
Little Piney Creek	25.0	mi.	Mouth to 21,35N,08W	Phelps
Little Black River	3.0	mi.	Mud Puppy Natural History Area S22,T24N,R3E to S25,T24N,R3E	Ripley
Log Creek	0.4	mi.	Bonanza Conservation Area	Caldwell
Meramec River	8.0	mi.	Adjacent to Meramac State Park	Crawford-Franklin
Meramec River	3.0	mi.	Adjacent to Onondaga and Huzzah State Forest	Crawford
Mill Creek	5.0	mi.	Mark Twain National Forest	Phelps
N. Fk. White River	5.5	mi.	Mark Twain National Forest	Ozark
Noblett Creek	5.0	mi.	Above Noblett Lake, Mark Twain National Forest	Douglas-Howell
Onondaga Cave Branch	0.6	mi.	Onondaga Cave State Park	Crawford

Waterbody	Miles/Acres		Location	County(ies)
Pickle Creek	3.0	mi.	Hawn State Park	Ste. Genevieve
S. Prong L. Black River	2.0	mi.	Little Black Conservation Area	Ripley
Shoal Creek	0.5	mi.	Bonanza Conservation Area	Caldwell
Spring Creek	17.0	mi.	Mark Twain National Forest	Douglas
Spring Creek	6.5	mi.	Mark Twain National Forest	Phelps
Taum Sauk Creek	5.5	mi.	Johnson's Shut-Ins State Park Addition S23,T33N,R2E to S5,T33N,R3E	Reynolds-Iron
Turkey Creek	4.6	mi.	Three Creeks Conservation Area	Boone
Van Meter Marsh	80.0	ac.	Van Meter State Park	Saline
Whetstone Creek	5.1	mi.	Whetstone Creek Conservation Area	Callaway

***Source for all tables in this appendix is 10 CSR 20-7.031, Water Quality Standards**

APPENDIX H

Waterbodies with Water Quality Problems Not Quite Severe Enough to be Placed on the 303(d) List

Waterbodies with Water Quality Problems not Quite Severe Enough to be Placed on 303(d) List

1. Waterbodies designated as drinking water supply sources with long term average atrazine raw and or finished water atrazine concentrations above 2.00 ug/l or cyanazine concentrations above 0.75 ug/l.

Schuyler Co. PWSD#1 Res.	Atrazine	Corn, sorghum production
Unionville Reservoirs	Atrazine	Corn, sorghum production
Monroe City South Res.	Atrazine	Corn, sorghum production
Lake Thunderhead	Atrazine	Corn, sorghum production
Marceline Reservoirs	Atrazine	Corn, sorghum production
Edina Reservoir	Atrazine, Cyanazine	Corn, sorghum production
Pape Res. (Concordia)	Atrazine	Corn, sorghum production
Breckenridge Reservoir	Atrazine	Corn, sorghum production
Adrian Reservoir	Cyanazine	Corn, sorghum production
Sugar Creek Res.(Moberly)	Atrazine	Corn, sorghum production

2. Waterbodies designated as drinking water supply sources which have long term average summer Chlorophyll-a concentrations above 40 ug/l. We consider these reservoirs to be at the greatest risk for chronic taste and odor problems in finished drinking water.

   Marceline Reservoirs
   Maysville Reservoirs

Note: Two other general categories of waterbodies might be considered for this list as a method of giving them the high priority they deserve: 1) streams draining areas with large confined animal populations, particularly if there is instream evidence of impact such as elevated concentrations of nitrate, 2) streams subjected to substantial physical alteration due to urbanization or other land use change.

*Source: John Ford, DNR-WPCP

APPENDIX I

Watershed Implementation

WATERSHED IMPLEMENTATION

Introduction

The term *watershed* refers to a geographic area in which water, sediments, and dissolved materials drain to a common outlet. This area is also called the drainage basin of the receiving waterbody. However, when working on an area for the protection of water quality, local decisions on the scale of geographic unit consider many factors, including the ecological structure of the basin, the hydrologic factors of underlying ground waters, the economic uses, the type and scope of pollution problems, and the level of resources available for protection and restoration projects. The waterbody/watershed is a functioning unit with interacting biological, physical, chemical and human components. If a waterbody suffers from problems often the cause of the problem can be linked to a source or sources within the watershed. In order for a water quality project to be successful it must take into account all factors of the watershed: local support, land use and potential for success.

Development and implementation of a consistent, coordinated and integrated process to guide watershed-based resource planning and management to protect, enhance and restore the state's watershed ecosystems to the benefit of all Missourians is the goal. The process involves local, state, federal and private land and water managers and interested citizens. A detailed discussion of watershed implementation assistance programs can be found in Appendix J.

Mark Twain Watershed Project (completed in 1997)

Management of the project was directed out of the Macon Water Quality Project Office and by the Natural Resources Conservation Service (NRCS) State Office. Technical specialists from the NRCS State Office, the University of Missouri Columbia (UMC), Extension Service (ES), Missouri Department of Natural Resources (DNR) and Missouri Department of Conservation (MDC) were also available to provide technical expertise. The project funds supported technical assistance personnel above the customary staffing level and water quality monitoring.

The Mark Twain project was located in northeast Missouri. The area, approximately 630 square miles (404,800 acres), included all of the drainage area of the Crooked, Otter and North Fork tributaries located within the hydrologic or political boundaries of Knox, Monroe and Shelby counties that empty into Mark Twain Lake. Upland and bottomlands of the basin are intensively cropped. Agricultural land comprises 55 percent of the project area's land use and is the number one industry in the basin. Soybeans, corn, wheat and other feed grains and forage crops are the major crops grown in the basin, and agricultural chemicals and pesticides are used extensively.

The basin is also a major hog producing region, with Shelby and Monroe Counties in the top ten of hog producing counties in Missouri. More than 300 swine facilities were in operation with an additional 100 dairy and beef operations in existence during the project. Animal waste produced has a human population equivalent of 144,500.

Soil erosion and rainfall runoff are the major hazards on about 80% of the cropland and pasture in the project area. Sediments are a problem, in that, they carry nutrients and chemicals attached to the clay/silt fractions that are deposited in the lakes and stream courses of the project area.

Project goals were to demonstrate and evaluate the effectiveness of total resource management plans (TRMP's) in addressing the resource problems within the area and provide technical assistance for the installation of animal waste systems. Plans utilizing an interdisciplinary team were developed and installed to assist in reducing the quantities of sediment and chemical pollutants (nutrients and pesticides) entering the water body system and being deposited in public drinking water supply reservoirs within the project area and to Mark Twain Lake at the mouth of the project area. Another major goal was to finalize the training of 16 NRCS field personnel in the formulation and implementation of nutrient/pesticides strategies, as part of the TRMP process. Three areas of training needed by NRCS personnel included crop/nutrient, soil fertility, and integrated pest management. The training was accomplished utilizing existing Extension In-service Education (ISE) programs, Certified Crop Advisory (CCA) classes, and Integrated Crop Management (ICM) course curriculum. This gave NRCS the base of expertise necessary to provide additional training to field personnel throughout the state for future planning activities.

Evaluation of project activities was accomplished by periodic meetings of the training advisory committee, and local, state, and private industry participants. Educational/informational needs, cooperator recruitment, and the monitoring program were reviewed, evaluated, and revisions made as necessary. A final report to DNR summarizes project accomplishments and revisions necessary to meet project objectives.

Project Period:January 1, 1993--December 31, 1997

Sponsor:	USDA-Natural Resources Conservation Service	
Funding:	EPA/DNR	$585,200
	Nonfederal match	$478,800
Contact:	The Mark Twain Water Quality Initiative 28898 US Highway 63 Macon, MO 63552-9587 Telephone: (816) 385-6359	

Upper Shoal Creek Watershed (completed in 2000)
Poultry Litter/Nutrient Management Demonstration

The Poultry Litter/Nutrient Management Demonstration Project supported technical assistance for the Southwest Missouri Resource Conservation and Development, Inc. (RC&D) office to provide a nutrient management specialist in the Upper Shoal Creek watershed. The specialist was employed by the Southwest Missouri RC&D and stationed in the Barry County Soil and Water Conservation District (SWCD) in Cassville, MO.

Further down in its watershed, Shoal Creek supplies drinking water for 10,000 people in Neosho and 45,000 in Joplin.

The 59,400-acre Upper Shoal Creek watershed is located in Barry and Newton Counties in southwest Missouri. Land use in the watershed was estimated to be 73 percent grassland, 20 percent forest land, 5 percent other (water, roads, farmsteads) and 2 percent cropland. Many poultry companies have facilities in this watershed. Annual poultry production in southwest Missouri was about 190 million broilers and 20 million turkeys at the time of the project. This production generated approximately 465,000 tons of litter per year. Broiler production is increasing annually.

Excessive nutrients are potential problems to the tributaries, springs and groundwater resources of Southwest Missouri and its downstream neighbors. Nutrient sources in the Upper Shoal Creek watershed included municipal wastes, livestock and poultry wastes and fertilization. Water quality data for the nearby Elk River showed increasing levels of nitrogen and bacteria in streams over time, believed to be due primarily by land application of animal wastes. Monitoring of water quality in Shoal Creek suggested it is also affected by land application of animal waste.

Protection of the drinking water supply by controlling (karst terrain) groundwater infiltration and surface runoff to reduce nutrient delivery and control soil erosion were the two major issues to be addressed in the management of poultry production lands draining into Upper Shoal Creek. Consideration was also given to the federally threatened, state-endangered Ozark Cavefish, the state-endangered Little Purple Mussel and a variety of other animals and plants on the state-listed watch list in this watershed.

Sponsor objectives were: (1) to provide direct technical assistance to producers in the project area to plan and implement nutrient management plans for reducing and controlling nutrients (promoting appropriate poultry litter land application rates) in the project area; (2) to monitor nutrients (N, P, K) in soils, streams, springs, ponds and wells at selected demonstration sites; (3) to monitor land use in relationship to long-term management practices; 4) to use results of the project to evaluate guidelines for poultry litter nutrient applications; and 5) to reduce and control nutrient concentrations leaving the fields in surface runoff or by leaching to the groundwater resource.

Project Period:1995--2000

Sponsor: Southwest Missouri RC&D Council, Inc.

Funding:	EPA/DNR	$378,700
	Nonfederal match	$309,845

Contact: Rita Mueller
Southwest Missouri RC&D Council, Inc./Barry Co. SWCD
Plaza Southwest Center, Suite 301C
West Highway 60
Republic, MO 65738
(417) 732-6485

Loose Creek Water Quality Initiative Project (completed in 2000)
The Loose Creek Water Quality Initiative Project supported technical assistance, animal waste handling equipment and construction for the Osage County Soil and Water Conservation District (SWCD) to demonstrate, develop, and implement sound nutrient management practices in the watershed.

The Loose Creek watershed consists of approximately 45,000 acres (12% of county acreage), 19,200 acres of woodlands, 16,700 acres of pasture and hay ground, 5,900 acres of row crops and small grains, and 3,200 acres in cities, communities and home lots. The 248 farms in the watershed consist of 25 poultry producers (1,000,000 one-time capacity), 35 swine producers (40,000 head), 2 dairy operations (200 head) and 112 beef farms (5,600 head). Over the past two decades, confinement livestock production has increased significantly in Osage County. Swine and poultry producers have also intensified their production. In 1975, 500 plus farmers produced 48,500 head of swine while in 1991 slightly less than 300 farmers produced 92,600 head. Poultry production has intensified much the same way. In 1987, 43 turkey producers had a one-time capacity of 585,000 birds; when this project started, 25 producers had a one-time capacity of 1,000,000 birds. These operations produce approximately 45% of the swine and 75% of the poultry produced in the county. A relatively small percentage of the county's acreage is used to produce a large percentage of the swine and poultry. This situation concentrates animal wastes in a small segment of the county.

Animal waste management is a major resource concern in the Loose Creek watershed. More animal waste is generated on farms in the watershed than can be land applied under approved management plans utilizing current practices and technology. Topography, gently sloping to steep (2 - 35% slope), causes additional concern as the majority of the land available for a soil plant filter is greater than 10% slope, which has limited use for land application under current regulations. As of the project’s beginning, only two swine operations in the watershed had an approved animal waste management system.

The overall objective of the project was to improve water quality through adoption by producers of sound nutrient management practices. This was achieved primarily through the proper handling and usage of waste generated by poultry, swine, dairy and beef operations. The project coordinator was the pivot point of all activities tied to this project. Assistance from other agencies included: (1) University of Missouri Extension, livestock specialist that provided expertise in livestock management; (2) An Extension ag engineer that provided assistance with system analysis, farmstead planning and land application of animal/poultry waste; (3) The Natural Resources Conservation Service (NRCS) did the technical design of animal waste facilities; (4) An Extension farm management specialist provided assistance to participating producers with economic analysis of proposed changes/systems prior to detailed design and construction; (5) An NRCS nutrient management specialist worked with a regional Extension agronomy specialist in advising producers on cropping systems related to animal waste and nutrient management; (6) A local field technician provided the necessary surveys and on-site work in support of the project. The NRCS engineer worked closely with the Extension engineer in the overall planning of facilities and provide the technical designs for proposed animal waste management facilities as required by the DNR for construction and acquisition of the necessary Letters of Approval.

Project Period: August 1, 1995--May 31, 2000

Sponsor: Osage County Soil and Water Conservation District

Funding:

Funding:	EPA/DNR	$492,050
	Nonfederal match	$402,500

Contact: Osage County Soil and Water Conservation District
P. O. Box 588
Linn, MO 65051
Telephone: (573) 897-3797

Fellows/McDaniel Lakes Watershed (completed in 1998)
This project focused on the City of Springfield's two water supply reservoirs on the Little Sac River: McDaniel and Fellows Lakes. McDaniel Lake, completed in 1929, stored 1.46 billion gallons of water. Fellows Lake (1955), 3 miles upstream, stores 10.1 billion gallons. The combined watersheds of these reservoirs are about 39 square miles, (25,000 acres).

Both reservoirs have experienced nutrient inputs of concern to water supply personnel. Studies of the lakes over a five year period, 1983-1987 indicated that McDaniel Lake was moderately eutrophic and Fellows Lake was at the upper end of mesotrophic. A watershed study started in 1983 as a response to severe taste and odor problems in the water supply. These problems were related to algae blooms believed to have been stimulated by excessive nutrient input from the watersheds. Agriculture was then the predominant land use in the watershed.

This watershed project utilized a comprehensive approach to watershed management aimed at preventing further water quality degradation of these important drinking water sources. The two categories of nonpoint source pollution believed to constitute the greatest water quality threats at the time of the project were addressed - runoff from agricultural activities, primarily cattle operations; and septic tank leachate from systems in marginal sites and soils.

The outreach plan contained a video/slide presentation to document the monitoring, best management practices (BMPs) implementation and results from the agricultural runoff demonstration project. Also included were fact sheets on the BMPs. A practical guide to performing site evaluations for local inspectors, engineers, soil scientists and other persons who have a stake in the successful performance of on-site sewage systems is under development as well as video tapes/slide shows /brochures and technical sheets to be used as training tools on job site evaluations. A special plan was developed for monitoring on-site wastewater systems in karst terrain.

While this project agreement culminated, the demonstration, education and monitoring efforts are on-going. A summary follows. During the early years of the project a clean lakes study was also taking place on McDaniel Lake. Over the sampling period of the study the lake water quality showed improvement.

Project Period:	1992 - 1998	
Sponsor:	Watershed Committee of the Ozarks	
Funding:	EPA/DNR	$63,000
	Nonfederal match	$56,000

Contact: Loring Bullard
Watershed Committee of the Ozarks
300 West Brower
Springfield, Missouri 65802-3817
(417) 866-1127

Project Summary
A study was implemented between 1982-1988 by City Utilities of Springfield. This study was prompted by taste and odor problems and subsequent public concern; the result of decaying algal blooms. Phosphorus, because of its role in algae production, was the main nutrient of study. The tributaries that exhibited the highest concentrations of phosphorus were those associated with dairy operations that had overgrazed slopes - the biggest contributor being a tributary (referred to as R-16) to the Little Sac River. R-16 has been extensively monitored ever since.

The steering committee for this project began in 1992. The committee consisted of representatives from City Utilities of Springfield, NRCS, Agricultural and Stabilizations & Conservation Service, University of Missouri-Extensions, Greene County Soil & Water Conservation District, Missouri Department of Conservation, Watershed Committee of the Ozarks and local landowners based throughout the watershed. As a result, the Watershed Committee of the Ozarks was able to contract with local cooperators for a cost-share effort to implement best management practices.

There were five demonstration and monitoring sites. 1) Gary Lewis Farm, 2) Eddie Smith Bar S Ranch, 3) City Utilities of Springfield Demonstration Farm, 4) Hugh Brewer Low-Pressure Pipe Site, and 5) Crystal Cave Spring.

1) Gary Lewis Farm Demo

Solar powered pump system and shallow alluvial well, fresh water stock tanks at the elevated pasture level, riparian fencing 100' from spring and a dairy waste collection and management system were added to this 65 dairy cow operation. Solids and liquids were separated in the management system, and solids were removed to spread on pasture for fertilization. It was noted that frequency of solids removal is necessary for optimum liquid separation to occur. Due to sediment accumulation in the pump filters and geology constraints, pipes to the solar powered pump system were later diverted to an existing well and the solar panels and pump were relocated to a different project.

Before Prior to this demonstration, dairy cows had direct access to the spring. Devegetation was evident in the spring area and animal waste was deposited

directly into the spring where dairy cattle were contaminating their own drinking source and nutrients were ultimately making their way to the Little Sac River. The cows tended to stay in the cooler area and would not graze as is desired for optimum weight gain. Many calves were observed in poor condition with fatalities being noted. This operation was suffering economically.

After — Economic viability of the dairy operation was rediscovered and nutrient and sediment loading to the R-16 tributary and ultimately the Little Sac River was reduced. No calf fatalities have been observed at this operation since the implementation of best management practices. Cattle have grazed more, animal waste has been more evenly distributed across the pasture and the cows' water supply is cleaner. The added best management practices are now part of daily operations.

<u>2) Eddie Smith Bar S Ranch Demonstration</u>

This site is located in the upper end of the R-16 tributary, west of the Gary Lewis farm. This is a cow/calf operation with a few horses. The herd would water in the drainage area where a small spring exists. Denuded slopes and erosion were prevalent. Cost-share assistance was made available to this operation for watering site relocation and riparian revegetation. This spring was retrofitted to pump water to a higher location, using electricity from residential power lines. The central water system was strategically located on this elevated area to allow access from different pastures. The riparian corridor was also fenced to allow revegetated growth to serve as a buffer.

Maintenance and management for this site has been minimal as compared to the Gary Lewis Farm Demo. These practices demonstrate cost-effective, low-maintenance ways to protect water quality while potentially enhancing the economic value of an agricultural operation.

<u>3) City Utilities of Springfield Farm Demo</u>

The City Utilities of Springfield Demonstration Farm is located at the confluence of the R-18 tributary and the Little Sac River. Best management practices implemented at this site include riparian corridor establishment, solar water system, solar fencing system and pasture enhancement with management intensive grazing.

Before — Riparian areas along the streambanks of the R-18 and the Little Sac River exhibited eroded and incised banks. Algal mat potential was evident. Land was leased to local residents for hay production.

After — Dramatic improvement is evident five years after re-establishment of the riparian corridor. Activities included fencing, sycamore planting and willow-staking in bank areas, multiple species tree planting in upper riparian area and coconut-fiber biolog implanting in a particularly eroded tributary bank. Diverse species of birds and fish that have never been observed at this site are now present. Aesthetics and habitat have improved considerably.

Solar panels power a water pump 50 yards away, and water is supplied to four stock tanks. Lessons learned from the Gary Lewis farm demo resulted in adequate an adequate chert and gravel alluvium, thereby preventing sedimentation problems in the filters. The only problem encountered was pump damage due to frozen pipelines. Burying the water lines deeper or shutting off the pump in severely cold weather would have prevented this breakdown. Another solar panel was installed for charging the electric fence. On one occasion, bird droppings contributed to reduced generation capacity. Panels are inspected more frequently to avoid this problem.

A management intensive grazing system was developed. Demonstration was provided for different methods of incorporating warm and cool season grasses into divided paddocks (pasture cells). Outstanding growth is evident and these pastures are now being grazed by a twenty-head herd of beef cattle supervised by the Southwest Missouri State University Agronomy Department. A small herd of horses is being grazed in other paddocks as well.

Analysis of the R-16 Tributary

The R-16 tributary has historically exhibited elevated levels of phosphorus. The Gary Lewis Farm and the Eddie Smith Bar S Ranch are located at the headwaters of the R-16 tributary and have been implicated as potential sources of phosphorous loading. Over sixteen years of monitoring from 1983 to 198, trends in phosphorous levels have generally decreased. Though decreasing trends may be interpreted in part to the practices implemented in this program, it should be noted many external factors such as temperature, sol radiation, rainfall intensity and frequent, and her size could impact trends as well. A qualified analysis of trends is available upon request.

Education and Demonstration Awareness

Numerous field trips have been conducted at these demonstration sites by many organizations and agencies and will continue in the future. The audience has included the agricultural community, teachers, college students and resource managers. Signs are posted to inform local residents of the implemented cooperative efforts.

4 & 5) On-site Wastewater Demonstration at the Hugh Brewer Residence and Ed Mills Residence

Cost-share assistance was provided to the landowners for the construction of their systems only for costs above the price of a “standard” conventional system. The Watershed Committee of the Ozarks monitored performance of the systems.

A low-pressure pipe septic system was installed at the Hugh Brewer residential site. This was chosen as a reasonable alternative to the conventional septic tank systems unsuitable in Greene County due to geographical constraints. This system incorporates an intermittent dosing cycle that enhances treatment of the effluent by allowing the soil to rest between cycles. An alarm is

in place to alert the homeowner if the pump fails. If the homeowner understands the system and provides adequate maintenance, the pump should not fail.

A shallow-trench conventional system was installed at the Ed Mills residence. This consisted of a conventional system with shallow lateral lines buried at a minimum of 18 inches due to a restrictive layer of clay. No problems were observed with the maintenance of this system and surfacing wastewater has not been detected even though the lateral lines are quite shallow.

Analysis of On-Site Wastewater System Demos

The Hugh Brewer low-pressure pipe system adequately treated its waste. Some months were too dry to collect samples. Monitoring and analyses will continue. Analysis at the Ed Mills site could not be completed due in part to lack of soil moisture conditions and a prolonged delay in the construction of the residence. Monitoring and analyses will resume in the future.

Other Project Elements

The Watershed Committee of the Ozarks also participated in a spring sampling plan (affiliated with other studies) in the Fellow-McDaniel Lakes watershed. Twelve springs were sampled for a variety of analytical parameters. The purpose of this program was to form a database on the shallow groundwater system and analyze land use impacts upon it. The results of this study suggest some springs may be under the influence of wastewater contamination.

In addition to the numerous field trips to the demonstration sites described above, the Watershed Committee of the Ozarks completed home sewage surveys, developed brochures, published articles and sponsored and participated in numerous public events highlighting the elements of this project.
Detailed information and formal studies affiliated with this project can be obtained by contacting the Watershed Committee of the Ozarks in Springfield, Missouri, at (417) 866-1127.

Osage Fork of the Gasconade River Watershed (completed in 2001)
The Osage Fork Livestock Waste Management Project supported technical assistance for the Laclede County Soil and Water Conservation District (SWCD) to provide a Resource Management Specialist and a Pumping Technician in the watershed. The specialist and technician were employed by the Laclede County SWCD and stationed in the Lebanon, Missouri office.

Common uses for the streams within the Osage Fork watershed include year-round recreational fishing, boating, swimming, and livestock and wildlife watering. The Gasconade River and nearby aquifers are used as a public drinking water supply by approximately 70,000 residents. Approximately 48,000 of those residents drink groundwater derived from bedrock aquifers, many of which are vulnerable to contamination due to their karst topography nature.

The 325,000 acre watershed contains approximately 250 dairies (totaling an estimated 36,000 dairy cows) and 36,000 head of beef cattle with 7% cropland, 33% forest, 50% pastureland, 7% urban/farmstead roads, 1% water and 2% public ownership.

Many acres of the pastureland are currently overgrazed, producing sediment runoff and resulting in deterioration of water quality and soil conditions. Excessive sediment runoff decreases the moisture available to plants for development, increases the sediment load, increases the contamination of surface water sources and decreases the holding capacity of surface water sources. This condition, when coupled with the karst nature of the Ozark region, makes the area highly vulnerable to surface and groundwater contamination. The Osage Fork watershed is home to the Bluestripe and Least Darters, among several other species, which are listed as either Rare, Endangered or on a Watch List.

Sponsor objectives were: (1) to provide technical assistance (through outreach and demonstration) to area producers in planning for and implementing best management practices to reduce groundwater and surface water contamination; 2) to routinely monitor nutrients (N,P,K) and other nutrient levels in soils at designated waste application sites; 3) to routinely monitor nitrogen, dissolved oxygen and macroinvertebrates in area streams and springs at or near selected demonstrations sites; 4) to develop guidance materials recommending acceptable effluent application rates for nitrogen and phosphorus and related acceptable best management practices; 5) to survey landowners before and after demonstrations to determine effectiveness of project; 6) to monitor land use and how it will affect long-term management practices; and 7) to reduce and control nutrient concentrations leaving the fields in surface runoff or by leaching to the groundwater resource.

Project Period:1996--2001

Sponsor:	Laclede County SWCD	
Funding:	EPA/DNR	$464,760
	Nonfederal match	$380,259

Contact: Laclede County SWCD
Joyce Johnson
Route 6, Box 373C
PO Box 1015
Lebanon, MO 65536
(417) 532-6305

Miami Creek/Drexel Reservoir Watershed (completed in 2001)

The project encompassed approximately 80,000 acres of land within Bates County, Missouri. The watershed is made up of three hydrological units within the Upper Osage/ Marais des Cygnes River Basin. Included within this project area is the Butler Municipal Reservoir, the city's intake located on Miami Creek, and the Drexel water supply reservoir. Together, these supply drinking water to the cities of Butler, Drexel, Amsterdam and five public rural drinking water districts. These reservoirs are also used for recreational activities such as fishing. With the encroachment from the Kansas City Metropolitan area increasing, so is the demand for safe usable water in the area.

Results from water monitoring completed by the cities and the Department of Natural Resources have detected high levels of the herbicide atrazine in their water supplies. Atrazine was not the only concern in the project area; nitrogen, phosphorus, bacteria, and sediment were other major water quality concerns. Possible sources of contaminants in the watershed included several livestock facilities located in or adjacent to the Miami Creek flood plain and cropland primarily used in conjunction with a corn-soybean-small grain cropping rotation. This rotation typically involved application of atrazine in one out of three years.

The overall goal of the Miami Creek/Drexel Reservoir Protection and Restoration Demonstration Project was to improve and protect the quality of water throughout the watershed. The Miami Creek/ Drexel Reservoir provides water to approximately 8,500 residents, with this figure growing every day. Protecting the water quality in these two watersheds was accomplished by achieving the following objectives: inform, educate and demonstrate controlling chemical runoff, animal waste runoff and sheet and rill erosion by implementing best management practices. A project goal to reach greater than 95 percent of the land users to be educated about the proper techniques in protecting the water quality in the Miami Creek/Drexel Reservoir watershed.

Project Period:	1996 -- 2001	
Sponsor:	Osage Valley RC&D	
Funding:	EPA/DNR	$507,712
	Nonfederal match	$415,401

Contact: Osage Valley RC&D
Stephen Wilson
100 Wesmor, Suite 2
Clinton, Missouri 64735
(816) 885-5052

James River/Table Rock Lake Watershed Partnership (completed in 2000)
Table Rock Lake was created in Southwest Missouri in the late 1950s. It is a popular recreational lake, drawing millions of visitors a year. The waters in this region have been historically known as high quality resources. Fishing for bass, crappie, and other game fish, boating swimming, scuba diving, and other fresh water activities have been vital components to the area's economy. There have also been plans proposed recently to use Table Rock Lake as a drinking water source for the ever growing community of Branson. The growth of the area is phenomenal and is continuing. Branson, although not in the James River Basin, relies on the quality of the area's lakes for its economic viability. Branson housed over 6,000,000 visitors in 1994. It was expected that this number would increase to over 10,000,000 by the year 2000. The James River is a major tributary to Table Rock Lake and has portions of the city of Springfield within its watershed.

Water quality monitoring results from recent years show trends of higher total phosphorus, total nitrogen, and chlorophyll levels and lower Secchi disk readings in Table Rock Lake near the

dam. One of the main purposes of the study was to discover the sources of nutrient enrichment in the lake. Increased loading of nutrients and sediments from recent development and from animal agriculture in the watershed have promoted algal growth and decreased water clarity. Nutrient rich wastewater additions come to Table Rock Lake from Springfield to the James River Arm of the lake and from numerous small treatment facilities as well as from nonpoint sources in the watershed.

A watershed partnership was designed to use the Table Rock Lake study and the coordination of all of its members to produce a whole-basin watershed management plan. It was important and appropriate to study the lake and watershed at this time to determine the causes of the decline. This gave us solid facts to use in a complete watershed strategy.

Project objectives included forming a James River Watershed Partnership composed of people who live work, and play in the James River Basin and was designed to protect that watershed. The partnership coordinated with the University of Missouri's Table Rock Lake Water Quality Study to determine more about the apparent decrease in water quality. The final output from this watershed partnership was the development of a whole watershed plan.

Project Period:	1996 -- 2000	
Sponsor:	Southwest Missouri RC&D	
Funding:	EPA/DNR	$147,914
	Nonfederal support	$ 57,252
Contact:	Southwest Missouri RC&D Rita Mueller/Pamela Anderson Plaza Southwest Center W. Hwy. 60 Republic, Missouri 65738	

Public Water Supply Watershed Management Education (completed in 1999)
Six public drinking water reservoirs in western Missouri were identified in 1994 as having atrazine levels exceeding the maximum contaminant level (MCL) of 3 ppb established by the Environmental Protection Agency (EPA). These lakes are located in Adrian, Dearborn, Drexel, Hamilton, Higginsville and Jamesport. The watersheds surrounding these lakes are primarily used for agricultural production. It was our intention to form a community based watershed alliance for each of the six reservoirs to ensure long-term management and compliance.

A project coordinator worked with the six identified communities for a three and one-half year period. The project coordinator provided overall leadership and assisted local Extension faculty with developing management strategies for area landowners and agricultural producers, helped establish watershed alliances within the communities, and developed a watershed based approach to insure water quality.

Selected Extension specialists working and living in the communities developed working groups that implemented an education program and developed a community watershed alliance. The education program will teach local citizens and officials how to develop strategies to protect their public water supply and enhance community involvement.

Project products will included: 1) examples of watershed management plans that can be used in other areas of the state; 2) local citizens groups established to monitor and ensure water quality standards of public drinking water supplies; and 3) best management practices implemented in the watershed for the reduction of atrazine plus other agricultural runoff.

Project Period:	1995 -- 1999	
Sponsor:	University of Missouri - Columbia, Extension	
Funding:	EPA/DNR	$306,757
	Nonfederal match	$250,930

Contact: University of Missouri - Columbia
University Extension
205 Agricultural Engineering
Columbia, Missouri 65211
(573) 882-0085

Niangua Basin Planned Grazing Demonstration (completed in 1999)
The Southwest Missouri Resource Conservation and Development Council (SWMO RC&D), Inc. received NPS funds to provide annual incentive payments to producers for implementing and demonstrating managed grazing systems that protect ground cover, reduce quantity and improve quality of runoff water, and provide more efficient forage production. The funds also supported soil testing and informational activities.

The project area included about 236,000 acres and contained intensive dairy and beef operations with emphasis on forage production, either for hay or pasture. The watershed is a karst area that includes sinkholes, losing streams, caves, and permeable soils. These areas are extremely vulnerable to contamination by allowing surface runoff to enter deep ground water or the Niangua River. The watershed area is also a major recreation area providing canoeing, fishing, and other outdoor activities. Bennett Springs State Park (a major trout fishing area) is also located in the project area. The final destination of the Niangua River is the Lake of the Ozarks.

Objectives of this project were: 1) to demonstrate best management practices for pasture management and utilization of animal waste to prevent nonpoint source pollution 2) to inform local and regional landowners of the economic and ecological benefits of proper pasture management and 3) to demonstrate riparian corridor protection as a part of the total farm system.

Grazing practices demonstrated:

Rest-rotation grazing: Multiple pastures (paddocks) leaving one or more idle each year.

Deferred rotation:	Discontinued grazing on different parts, allows each grazed part (pasture/paddock) to rest a growing season.
Twice-over rotation:	Rotates animals faster allowing for a long period of rest between rotations.
Start-duration:	Rotation using multiple pastures/ paddocks. Involves large herd, many small parts, and high stocking density.

Six livestock/dairy operations were selected to participate as model sites to demonstrate the effectiveness of grazing best management practices. Systems installed were customized to each producer. Incentive payments were provided for participation. Implementation of a total resource management system was required of each participating producer.

Demonstration farms participated in two to three annual tours jointly sponsored by University Extension, the Natural Resources Conservation Service and the SWMORC&D. A series of workshops were held each year to provide training to landowners and agency personnel working in the region. Participants gained knowledge in (1) plant growth, (2) plant management, (3) soil fertility, (4) species selection, (5) livestock needs, (6) water development, and other aspects of a controlled grazing system necessary to derive economic and environmental benefits of participation.

Site level monitoring was conducted and included annual soil sample collections of the individual paddocks within the grazing system to be tested for nutrients (nitrogen, phosphorus and potassium). Monitoring provided necessary parameters for on-farm evaluation of intensive grazing systems.

MDC will developed four stream wildlife riparian management areas. The Missouri Department of Conservation provided cost-share to install wildlife areas that included tree and shrub plantings, livestock exclusion, natural vegetation, tree revetments, riffle structures, rip-rap and anchored root wads.

Project period:	March 1, 1994 to December 31, 1999	
Sponsor:	Southwest Missouri Resource Conservation and Development	
Funding:	EPA/DNR	$101,000
	Nonfederal match	$ 82,636

Contact: Southwest Missouri Resource Conservation and Development
Plaza Southwest Center, Suite 301C
Republic, MO 65738
Telephone: (417) 732-6485

Fulbright Spring Urban Recharge Area Watershed (completed in 2000)
Fulbright Spring has been in use as a public drinking water source by the city of Springfield since the 1880s and continues to supply about twenty percent of the source water on an annual

basis. The approximate recharge area, roughly defined in the 1970s, was further refined through a 1990 EPA-funded wellhead protection monitoring system study. About one-third of the 23,000 acre inferred recharge area is within the city of Springfield and the remainder is in the unincorporated area of Greene County. A substantial portion of the spring's flow is derived from losses of surface streamflow in the upper South Dry Sac basin. Sinkholes in the basin have also been shown to contribute flow. City Utilities routinely monitors the spring for a host of Safe Drinking Water Act contaminants. Data indicate that the water quality of the spring remains relatively high in spite of occasional spikes of some parameters such as turbidity and fecal coliform, during storm events. This is not surprising given the open nature of this karst hydrologic system, with its high degree of surface - groundwater interaction.

Fulbright Spring is probably the most easily compromised of any of the city's raw water sources. The largest concern from a water treatment standpoint is organic chemical contamination such as biocides, hydrocarbons and solvents. The use of such materials in the spring recharge area is expected to increase with expanding urbanization. Without a protection program in place as urbanization proceeds, the spring would likely degrade to the point of requiring sophisticated and expensive water treatment processes or abandonment as a source. This project was designed to prevent that possibility.

The three major components of the project were: watershed and spring monitoring, best management practice implementation and monitoring, public education and public involvement.

Project Period:	1996 -- 2000	
Sponsor:	Watershed Committee of the Ozarks	
Funding:	EPA/DNR	$100,000
	Nonfederal match	$ 90,000
Contact:	Watershed Committee of the Ozarks Adam Coulter 300 West Brower Springfield, Missouri 65802-3817 (417) 866-1918	

Bryant Creek Tributaries Water Quality Demonstration Project (completed in 2002)
The boundary of this watershed project was Bryant Creek and its' tributaries within Douglas and Ozark counties. Bryant Creek empties into Norfolk Lake, a public water supply for the city of Mountain Home, Arkansas. The watershed is approximately 250,000 acres with more than 70 dairies, approximately 5,000 head of dairy cattle and an estimated 14,000 head of beef cattle. The water quality of Bryant Creek and its tributaries is potentially degraded by the presence of these dairy and beef cattle operations. Animal wastes, coming off-site from concentrated animal feeding areas, dairy milking parlors, loafing areas, improper rates and timing of manure applications to overgrazed fields and from direct deposition of animal wastes into creeks, have negative impacts on fish and other wildlife dependent on the streams for habitats and also for recreational users of the water resources.

At the time of the project, the primary impacts the animal wastes have on Bryant Creek watershed were nutrient loading through runoff. The nutrients of concern were nitrogen and phosphorous. High bacteria levels (fecal coliform and fecal streptococcus) and other pathogens were also a concern to recreational users of Bryant Creek, particularly swimmers, fisherman and canoeists. Douglas County and Ozark County rank 7th and 14th respectively in the state in milk cows and 21st and 33rd in the state respectively in beef cattle. Livestock wastes produced from these enterprises are considered to be a major water quality concern along with the excessive sedimentation caused by erosion in over-grazed pasture land and the lack of established riparian areas along streams of the watershed. Within the project area, there were only two permitted dairies, one in Douglas and one in Ozark County. The upper end of the watershed, located in north central Douglas County, had the greatest concentration of animal feeding operations with more than forty dairies.

The NRCS hired a full-time nutrient management specialist/conservationist whose primary responsibility was to coordinate the activities of the project area. Technical support was also provided by NRCS field office and area office staff in the design and installation of animal waste management systems. These NRCS staffs also provided assistance in developing resource and nutrient management plans for landowners in the watershed area. Staff developed 40 nutrient management plans written to address the vegetative filter strips along concentrated animal feeding/traffic areas, proper nutrient management through proper timing and spreading of manure applications, and intensive/rotational grazing systems establishment.

There were three animal waste management demonstration farms installed, four grazing management demonstration farms installed, and three riparian corridor management protection farms installed with alternative watering systems demonstrated. Once these demonstration farms were established, there was one tour or field day the first year demonstrating an intensive/rotational grazing system; two the second and third years demonstrating animal waste management systems, intensive/rotational grazing systems, and riparian corridor establishment and protection with alternative watering systems; and four the fourth and fifth years demonstrating the same systems as shown in the second and third years. To complement these animal waste demonstration systems and to assist other operations within the watershed in the proper utilization of animal wastes, animal waste spreading equipment was purchased the first year of the project.

There was also volunteer monitoring of Bryant Creek to determine trends in water quality within the stream. Stream teams trained in water quality monitoring conducted this monitoring.

Information, education and technology transfer were accomplished through the use of informational materials, demonstration field days, news articles, SWCD newsletters, radio public information programs and the Neighbor-to Neighbor program sponsored by the Douglas and Ozark County SWCDs. Soil and effluent testing, along with volunteer stream team monitoring, were also methods by which this will be accomplished. The target audience was primarily beef and dairy producers within Bryant Creek watershed.

Successes were documented by the implementation of BMPs that were written into resource and nutrient management plans for landowners in the watersheds. The BMP implementation used to measure the success of this project were the installations of successful animal waste management systems, acres of pasture land put under intensive/rotational grazing management systems, lengths of riparian corridors established and streambanks stabilized and protected, numbers of alternative watering systems installed, tons of manure properly utilized, and general changes of attitudes by landowners in the watershed as determined by surveys.

Project Period: November 15, 1997--November 14, 2002

Sponsors: Douglas and Ozark Counties' Soil and Water Conservation Districts

Funding:	EPA/DNR	$474,086
	Nonfederal match	$328,390

Contact: Mr. Gregory B. Watkins
Douglas County SWCD
P. O. Box 837
Ava, MO 65608
(417) 683-4816

Turkey Creek Watershed Protection Project (completed in 2002)
The Turkey Creek watershed project area encompasses 61,000 total acres with the majority of the project area, approximately 57,750 acres, being in Carroll County, while approximately 3,250 acres is located in Ray County. At the time of the project, there was no urban land located within the drainage area. Land uses in the project area includes an estimated 60 percent in row crop production; 30 percent in grassland including Conservation Reserve Program (CRP) land; and the remaining 10 percent is devoted to other uses such as roads, farmsteads, and livestock facilities. There are approximately 310 landowners located in the project area, which is all agricultural. Row crop farming is the primary land use for the area, but there are several fairly large livestock confinement units for hogs, beef cattle, and dairy cows. While none are large enough to require a permit, eleven are registered with the DNR as Class II operations. Most of these operations have a small lagoon and apply waste products by spreading the material over fields near the waste storage structure. Timing of the present applications is not always the best for water quality.

Excessive chemicals, nutrients, and animal wastes were problems identified by the Department of Natural Resources in the watershed. Landowner contacts resulted in the same concerns being identified, and the producers are searching for solutions both to take care of the environment and to stay in compliance with all governmental regulations. The objectives identified by landowners were to improve waste treatment and handling for each livestock operation, to reduce the amounts of pesticides and fertilizers applied to cropland, to further reduce the level of soil erosion and sedimentation, and to treat 75 percent of CRP ground released with no-till farming, rather than conventional tillage. Grant funds were not used as incentive payments to support no-till farming.

Producers in the Turkey Creek watershed were asked to develop Total Resource Management (TRM) plans which include BMPs for livestock waste management, the proper use and application of pesticides and fertilizers, and the installation of erosion control practices to reduce sedimentation. Cost-share incentives were available to those producers who developed and implemented plans to improve water quality. Integrated crop management specialists from the private sector, the Natural Resources Conservation Service (NRCS), and the University Extension Service were available to advise operators on the proper use and application of pesticides, animal waste and fertilizer. An incentive was offered to those producers who use this service to properly apply correct amounts, which should reduce the runoff of improperly applied or over applied chemicals. Funding to install these practices came from the AGNPS SALT Cost-Share Program administered by DNR's Soil and Water Conservation Program and from the Federal Environmental Quality Incentives Program.

There had been no water quality sampling in the past that the District is aware of, but the Stream Team from Norborne High School agreed to sample water at two locations recommended by WPCP staff which include one site on Turkey Creek upstream of the confluence of Wakenda Creek and one site on East Fork Wakenda Creek near the confluence of Wakenda Creek. The Stream Team monitored water temperature, pH, conductivity, nitrate-N, ammonia-N, phosphorus, dissolved oxygen and macroinvertebrates.

The Turkey Creek Watershed Protection Project had the goal of informing and educating 95 percent of the land users within the project area. To accomplish this goal, an ambitious information and education program was scheduled. Eleven workshops targeting producers from all the major land use areas were conducted. Six field days at good demonstration sites were selected and toured during the project, which included a waste management demonstration and a streambank stabilization site.

Fact sheets relating to BMPs and ICM were developed and published in a joint effort of the SWCD, NRCS and University Extension. A landowner survey of land users' knowledge of BMPs was taken at the start of the project and again at the end to measure results of the educational efforts. Success stories from the use of BMPs and ICM were compiled and published to share with operators in the project area. A newsletter was published by the District twice per year during the life of the project and was mailed to all the landowners and operators in the project area. Additionally, news articles relating to workshops, field days, and project information were published in the local papers to publicize the project.

Project Period:	October 1, 1997--September 30, 2002	
Sponsor:	Carroll County SWCD	
Funding:	EPA/DNR	$257,555
	Nonfederal match	$171,705
Contact:	Mr. David Cain Carroll County SWCD Route 1, Box 211C	

Carrollton, MO 64633
(660) 542-3361

Bonne Femme Watershed Project (completed in 2002)
Residents of the Bonne Femme and Little Bonne Femme watershed in south central Boone County formed a partnership to identify local water quality problems and to develop community-based strategies to reduce nonpoint source water pollution in the watersheds. The 92.4 square mile project area includes Rock Bridge Memorial State Park, Three Creeks State Conservation Area, and four officially designated outstanding state resource waters (i.e., Turkey Creek, Bass Creek, Gans Creek, and Devil's Icebox Branch). The watersheds include diverse aquatic habitats that are characteristic of prairies as well as Ozark forests. Several endangered species are present in the area, including the Gray Bat, Indiana Bat, and Topeka Shiner. There are also extensive areas of karst topography and numerous caves in the watersheds.

At the time of the project, the project watersheds included a mix of cropland, pasture, forest, and residential developments. Economic pressures had been developing in recent years to expand residential, commercial and industrial development in the watersheds, especially along the Highway 63 corridor between Columbia and Ashland. This corridor is the headwaters for all major streams in the watersheds. Rapid and uncontrolled development in the Bonne Femme and Little Bonne Femme watersheds could significantly impact water quality in the outstanding state resources waters, threaten several endangered species in the watersheds, and disrupt sensitive ecological systems in Rock Bridge Memorial State Park and Three Creeks State Conservation Area. In selected areas of the watersheds, agricultural practices and urban development had already degraded stream banks and riparian areas. Current and future urban nonpoint sources of water pollution in the watersheds included microbial contamination from on-site sewage systems; storm water from residential, commercial, and industrial developments; sediments from construction sites; and nutrients and pesticides from residential lawns and development grounds.

The 319 project focused on stream restoration and prevention of urban nonpoint sources of water pollution. The Boone County Soil and Water Conservation District was funded by the Missouri Department of Natural Resources for a SALT AGNPS Project (Special Area Land Treatment - Agricultural Nonpoint Source) that addressed agricultural nonpoint sources in the watersheds. A Watershed Steering Committee was formed under the SALT AGNPS project and expanded to include additional stakeholders from the watersheds. The Steering Committee set priorities, establish objectives, and help coordinate implementation of the project (USGS 1994). Project activities were designed to increase watershed resident awareness and appreciation of water quality and stream issues, coordinate volunteer and agency resources for stream restoration, demonstrate urban best management practices, and provide technical assistance to watershed residents for implementing best management practices. Project activities were supported and guided by professionals affiliated with conservation, agricultural, and health agencies operating in the watersheds. The project included extensive inter-agency coordination between local, state, and non-governmental organizations.

Project Period: August 1, 1998 to July 31, 2002

Sponsor: Show-Me Clean Streams

Funding:	EPA/DNR	$255,030
	Nonfederal match	$245,569

Contact Person: James R. Davis, Ph.D.
Show-Me Clean Streams
9642 South Route N
Columbia, MO 65203
(573) 657-6108
(573) 882-3384

Little Niangua River Watershed Restoration
Originally, the Little Niangua River was the largest tributary to the Niangua River, but it now drains directly into the Lake of the Ozarks. Concentration of livestock along streams has destabilized a large portion of the banks of the river, as well as its tributaries, resulting in an increase of sediment and nutrient loading into the river, its lower reaches and the Lake of the Ozarks. Many efforts have been put forth by numerous agencies to address similar problems in the neighboring Niangua watershed. Those efforts to protect water quality have included demonstration projects, water quality monitoring, education activities and cost sharing for animal waste holding systems. These efforts are also needed in the Little Niangua River watershed to improve and protect water quality in the Little Niangua River and the Lake of the Ozarks.
This watershed was listed as #61 in the 1998 Missouri Unified Watershed Assessment.

PROJECT DESCRIPTION
The project will support the restoration and protection of streambanks and the establishment of rotational grazing systems with alternative water supplies. Tours and demonstrations will be given to create public awareness of how water quality and the environment are protected by the adoption of best management practices.

PRODUCTS
Alternative watering systems
Fenced paddocks
Educated livestock producers

Sponsor: Dallas County Soil and Water Conservation District

Cooperators: Natural Resources Conservation Services, the Department of Conservation and the University of Missouri Extension Program.

Contact: Joe Cooper
Dallas County Soil & Water Conservation District
RR 3, Box 80, S Hwy. 65
Buffalo, MO 65622
(417) 345-2312

Elk River Water Quality Demonstration Project

The 483,000-acre Elk River Basin located within Missouri consists of Indian Creek, Little Sugar Creek, Big Sugar Creek, Buffalo Creek, Elk River, and their tributaries. The watershed is located in the most southwestern part of Missouri in McDonald, Newton, and Barry counties. The Elk River flows westerly entering Grand Lake of the Cherokees north of Grove, Oklahoma. The entire Elk River Basin drains about 870 square miles in Oklahoma, Arkansas, and Missouri.

Approximately 6,000 people live in the Elk River Basin. The basin is estimated at 68 percent grassland, 25 percent forest land, and 7 percent other--water, roads, farmsteads. There are about 1,500 farms/cooperators in the watershed (about 275 of these are confinement operations). Sources of pollutants within the Elk River Basin may include municipal and septic system wastes, livestock and poultry manure/litter, fertilizers, pesticides, sediment/erosion, and recreational use of the streams (human contact with streams and trash).

The Elk River, along with the Neosho and Spring rivers, flows into the Grand Lake of the Cherokees. According to a Missouri Department of Natural Resources (MDNR) report on the Grand Lake of the Cherokees, fecal strep and certain nutrients including phosphorus and nitrogen have been identified as posing a threat to the overall quality of that lake. Therefore, excessive nutrients are potential problems and concerns to the tributaries, springs and ground water resources within the drainage basin of the Grand Lake of the Cherokees.

This project will compliment the existing Poultry Litter/Nutrient Management Demonstration in the Upper Shoal Creek Watershed. In the Shoal Creek 319 project, poultry litter and soil samples are being taken on ten demonstration farms to develop nutrient budgets that tell how much litter should be applied to the land. Information learned from the Upper Shoal Creek Watershed will be used to the benefit of the cooperators and residents in the Elk River Basin and the rest of the poultry producing counties. The Elk River Water Quality Demonstration will show various practices. Landowners will be able to visit nearby farms within the basin to learn techniques to improve water quality.

The purpose of this project is to help prevent pollution through the use of demonstrations, water and soil quality monitoring, information/education, and technical assistance. The project will demonstrate four poultry litter stacking shelters, two litter hauling seminars, six grower nutrient management sites, two septic system maintenance/clean-outs, three riparian corridor repair and management sites, and three livestock and pasture management systems. The Elk River Water Quality Demonstration project will illustrate various practices that if implemented will contribute to improved water quality in the watershed.

An Elk River Basin brochure will be produced to increase water quality awareness. Stacking shelter guidance materials will be produced and distributed. Soil samples will be taken on farms within the watershed during the project period. A video will be produced explaining nutrient management. Fact sheets, newsletters, news releases, and radio programs will be used to promote the practices demonstrated through the project.

Groups involved in the project include Southwest Missouri RC&D; NRCS; MOARK Productions; Simmons Industries, Inc.; Tyson Foods, Inc.; Missouri Poultry Federation; contract growers; litter haulers; livestock producers; Elk River Advisory Committee; McDonald, Newton, and Barry County Soil and Water Conservation Districts; Missouri Department of Conservation; McDonald, Newton, and Barry County Health Departments; septic system contractors; University Extension; United States Geological Survey; Missouri DNR; and EPA.

Project period: January 1, 2000--December 31, 2004

Sponsors: Southwest Missouri Resource Conservation and Development Council, Inc.

Funding:	EPA/MDNR	$454,400
	Nonfederal match	303,600
	Total Project Costs	$758,000

Contact: Southwest Missouri Resource Conservation and Development, Inc.
329 W. Highway 60
Republic, MO 65738
Rita Mueller (417) 732-6485

The Little Sac and Sac River Watershed Restoration Actrion Strategy Project

The Little Sac River watershed encompasses about 400 square miles of the 1970 square mile Sac River basin in southwest Missouri. There are two drinking water reservoirs and one 27-mile stream segment within this watershed on the state's final 303 (d) list. Nutrients and fecal coliform are pollutants responsible for the listing - nutrients for the two reservoirs and fecal coliform for the Little Sac River. Furthermore, the Sac River watershed is the #3 priority watershed in the recently completed "Unified Watershed Assessment." Concerns relate to nutrient enrichment, biological impairment, drinking water source protection, karst geology and large numbers of livestock in the basin. The entire Little Sac watershed is a public water supply source area containing two reservoirs, Fellows & McDaniel Lakes, plus Fulbright Spring and Stockton Lake, all utilized for municipal water supplies. The large intake on Stockton Lake is designed to serve the high growth areas of Springfield and Greene County for the next fifty years.

A minigrant to the Greene County Soil and Water Conservation District is supporting development of a Watershed Restoration Action Strategy (WRAS) for the Little Sac and Sac River. The WRAS will identify the seven elements specified by the Environmental Protection Agency, Region VII, as follows: (1) public outreach methods; (2) monitoring and evaluation activities based on water quality goals and outcomes; (3) specific water quality problems; (4) identify a watershed coordinator/evaluator; (5) blueprint of actions to be taken and desired water quality goals and outcomes; (6) schedule of implementation; and (7) funding needs.

Project period: November 1, 1999—November 1, 2000

Sponsor: Green County Soil and Water Conservation District

Cooperators: Natural Resources Conservation Service, Watershed Committee of the Ozarks, MO Department of Conservation, MO Department of Natural Resources

Contact: Larry Jones
Green Co. SWCD
688 S. State Hwy. B, Suite 200
Springfield, MO 65712
(417) 831-5246

Fox River Ecosystem Development Project
The 136,822-acre project area is located in northeast Scotland and northwest Clark counties in northeast Missouri. There are approximately 555 landowners in the watershed area. Land use in the watershed is estimated to be 47% cropland, 33% woodland, 15% pastureland and 5% other. The other 5% includes small communities on the fringes of the watershed area and three public use areas owned by the Missouri Department of Conservation. Watershed land usage is as follows: 65,334 acres of cropland (floodplain and upland), 43,363 acres of woodland, 19,925 acres of pastureland and 5,988 acres of public use area.

Critical areas that have a major impact on water quality in the Fox River are as follows. The big head cut in the main Fox River channel has a high sediment delivery rate. Livestock waste enters the Fox River at several areas because livestock have free access to the stream itself. Intensively cropped land immediately adjacent to the main stream and its tributaries are a source of silt and chemicals in the water. A water quality problem identified on the 1998 303(d) list was sediment in the stream. The Fox River Basin Management Plan conducted in October of 1992 by the Missouri Department of Conservation and Soil Conservation Service indicated no streams in the basin were classified for whole body contact due to turbidity, silty substrates and poorly sustained flow. Loss of aquatic habitat has been one result of siltation in the Fox River Channel. The head cut in the main channel of the Fox River is contributing to the siltation problem. Losses of riparian corridor areas have caused an increase in stream bank erosion in some areas of the river. Siltation has resulted in loss of wildlife habitat, reduced or lost recreational value, and lowering of water quality in the Fox River.

The goals of the Fox River Ecosystem Development Project are to protect and improve the quality of water in the entire watershed. This will be accomplished by achieving six major objectives:

Objective # 1:
The first objective is to inform, educate, and demonstrate controlling herbicides, pesticide and fertilizer runoff by 50% through adoption of BMPs in the watershed. Three demonstration projects will be established with land users to demonstrate BMPs. Six underground outlet discharge options will be demonstrated following guidance from NRCS Technical Note 31.

Objective # 2:

The second objective is to inform, educate and demonstrate controlling nutrient and chemical runoff from cropland by using Nutrient Management Plans and Pest Management Plans. Incentive payments will be made to the land users to reduce nutrient and chemical run off from cropland.

Objective # 3:
The third objective is to inform, educate, and demonstrate controlling animal waste runoff and infiltration by adopting BMPs. The project sponsors will provide project funds not to exceed 75% of the cost for the installment of two animal waste facilities and provide incentive payments for the proper application of animal waste. The sponsors will monitor the stream tributaries in the watershed to ensure the objectives of the project are being met and to provide data to inform land users of the benefits of using BMPs.

Objective # 4:
The fourth objective of the project will be completed by utilizing existing programs to develop a wetland area and to demonstrate the role wetlands play in controlling pesticide, herbicide and nutrient runoff. Monitoring will be done down stream to validate expected results on water quality. This information will be used to inform and educate land users and the public on the importance of wetlands on water quality and restore 200 acres of wetlands.

Objective # 5:
The fifth objective of the project is to establish one demonstration riparian corridor area along bare stream banks. Filter strips and livestock exclusion will be included in the demonstration areas. One BMP will demonstrate the proper use of riparian corridor management. These riparian corridor areas will be used to inform and educate land users and the public on the importance of riparian corridor management, filter strips and livestock exclusion and control livestock on 50% of stream corridors. One demonstration practice will be used to help educate land users about stream bank stabilization. These stream bank stabilization demonstrations will be in cooperation with the Missouri Department of Conservation.

Objective # 6:
The sixth objective of the project is improving wildlife habitat. This will be accomplished by landowners adopting the BMPs to reduce chemical and fertilizer runoff, reduce soil erosion, reduce animal waste runoff, developing wetlands and establishing riparian corridors. As land users observe the benefits of BMPs through the demonstration projects, the sponsors feel that the land users will want to continue these beneficial programs by adopting BMPs on a permanent basis.

Those involved in the project include: Clark County SWCD, Scotland County SWCD, the Northeast Missouri RC&D Council, USDA Natural Resources Conservation Service (NRCS), University of Missouri Extension Service, US Fish and Wildlife Service, Missouri Department of Conservation, Missouri Department of Natural Resources, National Turkey Federation, Pheasants Forever, Iowa State University, US Geological Survey, Iowa Department of Natural Resources, and Scotland County Health Department.

Project period: February 15, 2003 – June 30, 2006

Sponsors:	Northeast Missouri RC&D	$299,509
	EPA/DNR	$449,263

Contact: Tommy J. Deberry, RC&D Coordinator
Northeast Missouri Resource Conservation & Development Council, Inc.
Route 1, Box 73G
Memphis, MO 63555
Phone: 660-465-8551 Ext. 4

Team Up! Irrigation Project

The Team Up! Project will be carried out in the major irrigation areas of Missouri. The eighteen counties in the program account for over 90% of the irrigated acreage in Missouri. The project is a joint endeavor that seeks to reduce nitrate and other contaminant-degradation of Missouri ground water occurring from inappropriate practices of irrigators in the state.

The reasons water quality in Missouri is vulnerable are several fold. One is the nature of the crop-soil relationship in the state. Much of the new irrigation is on corn, watermelons, and potatoes, crops that traditionally have used high amounts of nitrogen. One of the first soil types put to irrigation is sandy soil, the soil that leaches the easiest. Thus high-use nitrogen crops and susceptible soils are often teamed together, creating a potentially dangerous situation for the ground water. It is important that water and nitrogen be balanced to ensure best yields and limited deep percolation of nitrogen. It is for this reason that best management practices be holistic and include management for water and management for nitrogen.

PROJECT DESCRIPTION

The eighteen largest irrigated counties in the state will be broken down into five units based on their proximity to each other. Each county has a county agent, called a Regional Specialist. The Regional Specialist will locate a cooperator who wishes to follow the water/fertility recommendations of the University. Full-scale uniformity tests will be conducted on pivot irrigation systems enrolled in the demonstration project each year. The cooperators will be paid a $3/acre incentive to schedule irrigation and record gypsum block readings. The one exception to this is the northeast unit, in which a summer technician will be hired to do the monitoring. Gypsum blocks and an accurate rain gage will be installed at each site. Local weather data from UMC weather stations will be imported into an irrigation scheduling program to calculate daily water use. The sites will be visited once a week and blocks read. The farmer or the technician will then plot the block soil moisture readings against the computer-generated soil moisture estimates to evaluate the irrigation scheduling estimates. Based on the computer recommendations and block readings the grower will decide when to irrigate.

OBJECTIVES

Objectives 1.) Irrigation scheduling: Increase the use of scientific irrigation scheduling by 100%. Approximately 15% of growers now use scheduling.

Objective 2.) Improving irrigation system uniformity: Test 150 pivots and have 50 pivots be re-nozzled to apply water more uniformly and make growers aware of the importance of uniformity.

Objective 3.) Decreasing pre-plant nitrogen amounts and any unnecessary N applications (decrease the pre-plant amounts of N on corn by 25%).

METHODS EMPLOYED

The goals are to decrease the amount of nitrogen and other agricultural chemicals leached into Missouri's ground water on irrigated soils by (a) increasing the use of scientific irrigation scheduling, (b) increasing irrigation system uniformity's, and (c) decreasing the amounts of pre-plant nitrogen applied and monitor to see if later applications are needed.

PRODUCTS

1) **40 Demonstrations, to include at each site:**
   - gypsum blocks down to 3 depths two different locations
   - rain gage
   - demonstration project sign
   - two marker, reference blocks 30' x 30' where ample N is applied
   - over flight of field to shoot foliage color
   - digitization of picture to make N recommendations given to the grower
   - uniformity of pivot tested and recommendations made

2) **3000 generated radio PSAs sent to local radio stations re: current water use rates**

3) **1200 generated newspaper tables and/or graphs sent to local newspapers re: weekly water use rates**

4) **web-based educational tools, to include:**
   a) a web-based fertigation rate calculator
      + calculates amount of N required and sizes chemigation pump

   b) ***a web-based fertigation recommendation generator***
      + it tells when to over-fly field, when to stop applying N, probability of rainfall based on historic patterns—not a good time to apply N

   c) a web-based chemigation equipment page

5) **20 field days/night meetings (based on RS's preferences)**

   And four Annual Irrigation Conferences that are multi-linked to up to 6 locations (Portageville,
   Mexico, Nevada, Columbia, Jefferson City and St. Joseph).

Cooperators: University Outreach & Extension, the Department of Natural Resources, Natural Resources Conservation Service (NRCS), Soil & Water Conservation Districts (SWCDs)

Sponsor: University of Missouri Columbia

Contact: Joseph Henggeler
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Stewardship Implementation Project (SIP)

In 1998, the Watershed Research, Assessment, and Stewardship Program (WRASP) was created. The goal of WRASP is to develop a better understanding of the causes of agricultural runoff and to help local people improve water quality in watersheds across the state. Building upon the successful implementation of WRASP and its programs, the Stewardship Implementation Project (SIP) will begin an implementation phase that will take the knowledge gained and apply it on the ground by working with farmers in their fields. The goal of SIP will be to accelerate implementation of agricultural production practices that increase the level of protection for the environment while maximizing profitability for producers through on-farm crop, conservation, and information management assistance. A specific goal of SIP is that the targeted watersheds be delisted from the Section 303(d) listing.

This project will accomplish its goals through direct one-on-one on-farm technical assistance and through field scale demonstrations of selected production practices, new technologies and management strategies. The program will utilize an Integrated Crop Management (ICM) systems approach to crop production. It will be unique to the specific watershed, field and grower. The program will demonstrate how ICM can improve profitability for the producers while decreasing the potential for pesticide, nutrient and sediment contamination of water runoff. The ICM production system, as utilized in this project, will encompass the best production techniques in terms of pesticide and nutrient management for both agricultural productivity and environmental stewardship. It is recognized that several individual activities and management techniques will comprise the components of the ICM system.

Participating farmers for their farmer neighbors will offer field tours of the side-by-side demonstration sites. These sites will provide in-field comparisons of conventional production systems and a comprehensive ICM system. Key producers in selected watersheds can share the details of their production practices and personal experiences with those in attendance, what was done, why, and how it worked on their farms. Information transfer, grower education and adoption begin here. Each demonstration site will be signed identifying the location as utilizing products, technologies, production practices and ICM systems for their economic and environmental benefits.

Water samples will be collected in streams and lakes in the project watersheds. The samples will be analyzed for various contaminants including pesticides, nutrients, and sediment. The sampling plan will not be as rigorous as the original WRASP project whereas the purpose of this sampling will be to document progress made in implementation.

The partners of WRASP are expected to continue to support SIP. These organizations include: the Missouri Corn Growers Association, Missouri Department of Natural Resources, Missouri Department of Agriculture, U.S. Environmental Protection Agency, Syngenta, Inc., U.S. Department of Agriculture-Natural Resources Conservation Service, U.S. Department of Agriculture- Agriculture Research Services, and the University of Missouri-Columbia. Besides Syngenta, it is expected that more corporate partners will participate in SIP.
As a component of this project, a survey instrument will be developed. This survey will measure the extent by which practices being promoted by the project are being adopted by the producers in the watersheds. The survey will estimate adoption of the pesticide, nutrient, and sediment management practices. The survey will be conducted throughout the project in order to access progress on an on-going basis. The Soil and Water Conservation Districts in the targeted watersheds will be asked how many acres they have enrolled in integrated pest management and nutrient management planning cost-share programs to measure adoption and implementation trends.

Tasks:
Identify to the extent possible the areas in watershed with the greatest potential impact on water quality as targets.
Establish and maintain working relationships with key producers and in areas targeted for greatest potential impact.
Establish and maintain field scale demonstration sites.
Data information management and decision support system developed.
Data information management and decision support system utilized by demonstration site cooperators.
Economic analysis completed on demonstration sites.
Field days conducted on demonstration sites.
Conduct information/education activities for the watershed.
Develop and implement the survey instrument for all landowners within the watersheds.
Develop, review, revise and implement water quality monitoring plan for assessing effects of BMP implementation on water quality.
Collect and analyze lake-level water samples for pesticide, nutrient, and sediment contamination
Collect and analyze stream-level water samples for pesticide, nutrient, and sediment contamination.

Priority Watersheds
Seven reservoirs and watersheds will be evaluated in the comprehensive study. These include the City of Vandalia reservoir, the Monroe City Route J Lake, the three-reservoir system serving the City of Cameron including Grindstone Lake, Smithville Lake and Salt River Basin of Mark Twain Lake. These lakes are listed by the Missouri Department of Natural Resources on the EPA Clean Water Act Section 303(d) list for the pollutant, Atrazine. The primary cause of this listing has been identified as agricultural non-point source pollution.

Project period: May 1, 2002 – April 30, 2007

Sponsors: Environmental Resources Coalition $135,000

EPA/DNR	$200,000

Contact:

Steve Taylor, CEO
Environmental Resources Coalition
3118 Emerald Lane
Jefferson City, MO 65109-6860
Phone: 573-893-4181

McCroskie Creek Watershed Project

There is 29,863 acres of upland in the watershed. Approximately 12,115 acres is cropland, and over half of the cropped acres are eroding at a rate of over 2 T (soil loss tolerance factor) per year. A very limited number of producers within the watershed are using Nutrient and Pest Management practices. Combining the excessive amounts of pesticides (primarily herbicides) and nutrients (fertilizer) being applied along with the erosion occurring at a 2 T rate creates a water quality problem when runoff enter the watershed streams which then outlets into the Missouri River. Producers over the years have removed or damaged approximately 60% of the riparian buffers. Fields are being tilled right to the bank of the streams. This creates bank instability, which leads to additional erosion as well as reduces the amount of habitat available for wildlife. In recent years, approximately 2,986 acres of the Conservation Reserve Program (CRP) ground and pasture has either been converted or returned to row crops. Livestock numbers (cattle) have increased approximately 15%. Cattle on most farms have access to streams on a daily basis. This creates a soil erosion problem as well as a water quality problem, which needs to be addressed.

PROJECT DESCRIPTION

The Carroll County Soil and Water Conservation District and the designated partners will provide technical assistance to complete the conservation practices listed under methods employed. With the use of workshops, tours, newsletters and demonstrations, the district will provide area landowners and producers with the education, information and technical assistance needed to achieve the goals set forth in this project.

OBJECTIVES

The objectives of the project are to improve water quality in the watershed and to treat unprotected croplands with soil saving conservation practices. The district will introduce best management practices like No-Till, Pest and Nutrient Management, Filter Strips and Planned Grazing Systems to area producers. Another objective is to introduce practices such as Marginal Pasture, CP9's, Contour Buffer Strips and Contour Stripcropping. Plans include implementing Waste Management Systems and Streambank Stabilization. Vertical outlets on Tile Terrace Systems will outlet into buffer strips before the drainage flows into the area water sources. By introducing and implementing these practices, producers will be holding sediment, nutrients and pesticides in place and reduce excessive amounts of polluted runoff from leaving treated acres.

METHODS EMPLOYED

The goals for this project are to educate the landowners and area producers on implementing best management practices and treat land eroding above T with the following conservation practices:

1) 280 acres of Terraces Systems with vertical outlets,

2) 525 acres of Cropland Protective Cover,
3) 14 acres of Sod Waterways,
4) 560 acres Planned Grazing Systems,
5) 25 Groundwater Flow Model Demo's
6) 28 Well Closings,
7) 200 acres of Permanent Vegetative Cover,
8) 150 acres of Filter Strips,
9) 420 acres of Marginal Pasture,
10) 280 acres of Contour Buffer Strips,
11) 280 acres of Contour Stripcropping,
12) 70 acres of Riparian Forest Buffers,
13) convert producers from using Conventional Tillage to No-Till on over 2,000 acres of the cropland,
14) introduce and implement both Pest and Nutrient Management on 2,000 acres of cropland, reduce the amount of herbicides and fertilizers that are applied by some 25%, and implement crop scouting on these same acres,
15) install four CP9 practices (shallow water area for wildlife),
16) build two Waste Management Systems,
17) develop demos on the application of Nitrogen and the stabilization of Nitrogen in crop fields,
18) and with the help of the Carroll County Commission (Bridge Department) re-establish Streambank Stabilization in 3 locations of approximately 350 total feet.

The funding for these conservation practices will be provided for by several different sources: 319 nonpoint source, AgNPS SALT McCroskie Creek, continuous CRP, Quails Unlimited, local state cost-share and U.S. Department of Agriculture cost-share

PRODUCTS
Two newsletters with achieved goals will be written, published and mailed to area landowners biannually (totaling 8 newsletters) over the life of the project.

Agendas will be printed for workshops and tours.

A brochure will be developed and published about the watershed and the achievements.

A report on the results of two landowner meetings will be summarized.

Quarterly reports will be written (one per quarter for the life of the project).

A final project report will be submitted to the department.

Cooperators: Missouri Department of Natural Resources, the Environmental Protection Agency, AgNPS SALT, Ray County Soil and Water Conservation District (SWCD), Natural Resources Conservation Services (NRCS), Missouri Department of Conservation (MDC), Norborne School Stream Team, Carrollton High School FFA Chapter.

Sponsor: Carroll County Soil and Water Conservation District

Contact: Pat Davis
Route 1, Box 211C
Carrollton, MO 63873

Computer Assisted Nutrient Management Planning
The Spring River and Elk River Basin have been identified as having degraded watersheds due to livestock nutrient loading. The James River Basin is identified as having degradation from riparian degradation, sediment and nonpoint source pollution. The area communities derive uch of their economic base from agricultural production, but the rocky terrain of the area and minimal soil depths make much of the area unsuitable for row-crop production, so residents have developed a stable economic base through dairy and beef cattle production and confinement poultry operations. The concentration of livestock and poultry numbers, combined with the poor soil conditions and lack of good management practices, allows nutrient laden manure and litter to run off area pastures and enter the waterbodies of the area. To maintain or improve the quality of life and provide economic stability for the watershed residents, nutrient management planning and implementation to reduce nonpoint source pollution from the livestock industry is essential. Nutrient management plans document work with individual producers on strategies they have developed to reduce nutrient loading due to over application or poorly managed manure spreading. Nutrient management planning efforts need to reach beyond the farmers producing the manure. Large amounts of manure can be exported from the farm that generates the manure to other farms. Spreading records of poultry growers associated with a packing plant in Sedalia Missouri indicate that over 60% of the litter produced on farms is exported. Nutrient management planning will likely lead to a higher percentage of manure being exported from the farm. Solving nutrient problems requires providing nutrient management planning opportunities to farmers receiving manure as well as farmers who generate the manure. Therefore, it is important to target both farmers with livestock and farmers that receive manure for land application on cropland, hayland or pastureland.

PROJECT DESCRIPTION
The project will focus on the development and implementation of a standardized nutrient management planning process using digital mapping resources and computer software that meets NRCS nutrient management standards and was developed by the University of Missouri and Purdue University. The project will target producers and landowners land-applying manure in a five county region in southwest Missouri for a pilot area. Lessons learned from the pilot portion of the project will be incorporated into “train-the-trainer” sessions designed to create nutrient management teams of NRCS, SWCD and UOE personnel. All individuals on the team will receive hands-on training on how to use the computer program and other digital nutrient management resources to develop accurate and efficient nutrient management plans. The project will accelerate the rate of BMP implementation because the plans use producer information and input, agency personnel will receive quality training and the computer software will increase the number and the quality of nutrient management plans written.

OBJECTIVES

Natural Resource Conservation Service (NRCS) estimates that it currently requires 150 hours to collect necessary farm operation information, write a nutrient management plan and work with the producer to implement the plan. They estimate it would take 32 full-time employees, 9 years to write nutrient management plans for all livestock and poultry operations in the state of Missouri. Farmers that receive manure also should have plans, which would require additional planning resources and time. This project will train agency personnel and private consultants to use computer-assisted processes to expedite the development of nutrient management plans for farm operations that use manure/litter as a form of plant nutrients. The project will deliver a computer-assisted model that uses producer input, technical assistance and computer based decision support for the development of realistic nutrient management plans.

The project has three phases:

1) develop training guide and class;
2) pilot the guide in the Elk, James and Spring River Basins; and
3) provide statewide "train-the-trainer" on-site sessions to develop resource teams throughout the state. The intent of the project is to provide computer software and other digital resources to increase the efficiency of agency personnel and private consultants developing nutrient management plans for farmers and to increase the effectiveness and quality of the plans. By using these resources, it is expected that the time necessary to write a nutrient management plan will be reduced by 50%.

Specific project objectives are as follows:

1. Implement a computer-assisted model for nutrient management planning that combines producer input, technical assistance and computerized decision support;
2. Increase producer knowledge and understanding about watersheds and water quality concerns and issues;
3. Facilitate development of nutrient management plans with farmer input to reduce nonpoint source pollution from agriculture runoff and leaching;
4. Encourage participants to implement nutrient management plans and work with local agency contacts;
5. Develop a brochure to increase awareness of the project and a website and list-serve to facilitate communication among nutrient management planners and promote discussion about resolving challenges in the nutrient management process;
6. Create a statewide network of NRCS, Soil and Water Conservation District (SWCD) and University Outreach and Extension (UOE) personnel capable of working together in nutrient management planning processes with the ability to use the tools necessary to expedite the development and implementation of nutrient management plans.

METHODS EMPLOYED

The University will:

1. Hire and supervise a Project Manager (1.0 FTE) that will develop and coordinate the nutrient management planning classes.
2. Hire and supervise a Computer/Technical Support Specialist (0.5 FTE) to support the computerized program for the pilot area and the statewide trainers as the program is implemented.
3. Ensure that all financial and progress reporting requirements are satisfactorily met.

The Project Manger will:

1. Develop materials for a manual used for the nutrient management course that will meet NRCS nutrient management planning standards.
2. Organize and present “train-the-trainer” sessions that will create a minimum of 3 training teams of 5 to 7 nutrient planners to pilot the project in the Elk River, James River and Spring River Basins (priority watersheds).
3. Work with the 3 training teams in the priority watersheds to train a minimum of 150 producers, yielding a minimum of 60 new or enhanced nutrient management plans.
4. Revise the manual and curriculum, using experience gained while working in the pilot area and the Interagency Technical Working Group as an advisory resource.
5. Develop and implement a quality assurance program to insure nutrient management plans being developed meet NRCS standards.
6. Deliver statewide “train-the-trainer” sessions to train at least 120 selected individuals organized into a minimum of 17 nutrient management planning teams statewide that will yield at least 60 new or enhanced nutrient management plans using the curriculum and the computer support.
7. Serve as a resource for the statewide teams implementing the program.

The Computer/Technical Support Specialist will:

1. Develop a supplemental manual for the trainers on how to use the computer software.
2. Provide training in the use of the nutrient management software and other digital resources.
3. Provide technical assistance to nutrient management trainers and producers using the program.
4. Resolve technical issues encountered by people using the digital nutrient management resources.
5. Create and maintain a web site for disseminating nutrient management resources and updates to the nutrient management planners and producers.
6. Create and maintain a list-serve to promote communication among nutrient management trainers and producers.

PRODUCTS

1. Project introduction brochure.
2. Training/Resource notebook.
3. Supplemental technical guidance manual.
4. List-serve and website.
5. A minimum of 120 computer assisted nutrient management plans.

Sponsor: University of Missouri-Columbia, Outreach and Extension

Cooperators: Natural Resource Conservation Service, McDonald, Barry, Newton, Jasper, and Lawrence Soil and Water Conservation Districts

Contact: University of Missouri-Columbia, Outreach and Extension
Curators of the University of Missouri,Sponsored Program Administration
University of Missouri – Columbia

310 Jesse Hall, Columbia, MO 65211
Dr. John Lory, (573) 884-7815

Hubble Creek Watershed Restoration Project

Hubble Creek watershed contains 44,875 acres of productive land in southern Cape Girardeau County, Missouri. Hubble Creek is suffering from water quality problems due to sediment. High concentrations of sediment in runoff water leave Hubble Creek and enter the Mississippi River. The sources of sediment are both agricultural and urban.

These sediment sources can be attributed to dramatic changes in the watershed's ecosystem during the last century. Changes affecting the lower reaches of Hubble Creek cause instability and headcutting. These factors allow vast amounts of sediment to remain in suspension and be delivered through the outlet and into the Mississippi. Dramatic changes in the upper reaches of the watershed greatly increase runoff to deliver higher sediment loads to the streams.

PROJECT DESCRIPTION:

This 319 funded Hubble Creek Watershed Restoration Project is the initial phase of the larger watershed improvement plan. Section 319 funds will be used to prevent nonpoint source pollution and restore water quality through the following mechanisms:

1. Offer additional incentive to CRP applicants who restore riparian buffers and establish innovative cross-corridor buffers.
2. Demonstrate the effectiveness of wetland filter areas by constructing one such area downstream from concentrated livestock operation.
3. Construct a rip-rap and sheet piling stabilization structure in a stream channel to control headcutting and stabilize streambank erosion.
4. Provide partial funding for a project manager who will manage these efforts and eligible portions of the larger Hubble Creek Watershed Improvement Plan during the term of this project.
5. Assist decision-makers in developing and implementing city and county ordinances for construction site erosion control and stormwater detention.
6. Provide partial funding for the information and education activities that are critical to this project's success.

OBJECTIVES:

A. The primary objective of this project is to restore more favorable water quality conditions within the Hubble Creek watershed. Sediment is the primary water quality problem in this watershed. The project objective is to reduce sediment load to the stream by 20%. This project will use funds from the 319 program to:

1). Develop and implement an information and education strategy and plan. This plan will be comprehensive and for the life of the 319 project. It will include publicizing the project's progress, monitoring and evaluation results and implementation. The plan will educate stakeholders and the public about the problems in the watershed and what services they can utilize through the project to help address problems. This will include efforts to make the stakeholders aware of the project, it's goals and who the partners and sponsors of the project are. This information and education plan will also include a process for stakeholders to have an

opportunity to contribute to and get involved in the project. Development and implementation of this plan will be the responsibility of the sponsors and their staff. This plan will be submitted to the department for review and approval.

2). Restore water quality by helping Cape Girardeau County and the city of Jackson develop and implement effective Stormwater Detention and Construction Site Erosion Control Ordinances. These ordinances and their enforcement will help control excessive runoff from new development sites in Jackson and the surrounding area. Goal will be to assist the city and county in enacting effective ordinances during the life of this project.

3). Restore riparian buffers along Hubble Creek and its tributaries. 319 funds will provide additional cost-share to supplement the Conservation Reserve Program (CRP) program for establishing riparian buffers. Currently, CRP pays 50% of the cost to establish/restore buffer strips. Participation is very low. This project will furnish an additional 25% to increase that incentive to 75%. These buffers will control erosion and remove sediment and debris as water enters and leaves the streams. Buffers will also improve aquatic habitat. Goal is to restore 20 miles of buffer strips along streams.

4). Restore water quality by establishing vegetative buffers across the flood corridors of the streams. These cross-corridor buffers will control erosion and remove sediment as flood water travel across the flood corridors. This is an innovative practice to improve water quality and wildlife habitat. A similar practice, developed with the Corps of Engineers in 1984 for Thompson Bend along the Mississippi River, has been largely successful. CRP would pay 50% to establish these strips. This project will provide another 25% for establishment. Goal is to establish 15 miles of these innovative strips across the flood corridors.

5). Demonstrate improved water quality by constructing an off-stream wetland filter area downstream from a damaging pollution site. Goal is to establish one wetland filter area of 5 acres.

6). Demonstrate the effectiveness of a rip-rap and sheet piling structure in the stream channel to control headcutting and streambank erosion. According to MDC stream managers, this type stabilization is necessary to stop headcutting and preserve stable streambanks before the riparian buffers can be expected to be effective. One structure needs to be constructed for demonstration and technology transfer. This type of structure has not been used in this area. Goal is to install one rip-rap and sheet piling structure.

7). Pursue other funding sources to enhance or continue the efforts to reduce nonpoint source pollution and restore water quality. The 319 funds will not be used to plan, design, promote or construct structures or practices where the primary purpose is for flood control.

8). Monitor and evaluate the 319 project's effectiveness throughout the life of the project. This will include water quality monitoring and evaluation of effectiveness of installed practices. This information will be used as a measure of success and also as a basis for any adjustments for the purpose of improvement. QAPP will be developed and in place to be used as a guide for monitoring and sampling for the project.

B. Another objective is to partially fund the broader Hubble Creek Watershed Improvement Plan. The watershed improvement plan represents a holistic approach to dealing with problems in this watershed. Other programs, other funding sources and other authorities will be required over the next several years to carry out the entire watershed improvement plan.

PRODUCTS

1. Develop and implement Information and Education Plan.
2. Install 20 miles of Riparian Buffers.
3. Install 15 miles of Cross-corridor Vegetative Buffers.
4. Implement Stormwater Detention and Construction Site Erosion Control Ordinances for Jackson and Cape Girardeau County. Goal is to limit runoff from new development not to exceed pre-development conditions according to USDA-NRCS Technical Release - 55 standards.
5. Install demonstration Wetland Filter Area.
6. Install demonstration Rip-rap and Sheet-piling Grade Stabilization Structure.
7. Pursue other funding sources to carry out Hubble Creek Watershed Improvement Project.
8. Reduce sediment loss from gully, sheet and rill, scour and streambank erosion by 20 percent in the Hubble Creek Watershed.

Sponsor: Cape Girardeau Soil and Water Conservation District

Cooperators: Cape Girardeau County Commission, City of Jackson, Missouri, Missouri Department of Natural Resources, Missouri Department of Conservation, USDA Natural Resources Conservation Service, USDA Farm Services Agency

Contact: Cape Girardeau SWCD
480 W. Jackson Trail
Jackson, MO 63755-2665
(573) 243-1467

Bonne Femme Creek Watershed – Water Quality Restoration Project

Bonne Femme Watershed encompasses an area of 59,702 acres in Southern Boone County. The watershed has several Outstanding State Resource streams combined with sensitive karst areas that are vulnerable to water quality degradation. The area is close to the rapidly growing cities of Columbia and Ashland. Population growth over the last ten years has increased at a rate of 40%, and high growth rates are anticipated over the next few decades. Losing stream are common in the watershed. Surface stream water, originating from the glacial upland areas, infiltrates directly into cave streams as exemplified by the streams in Devil’s Icebox and Hunter’s Caves. Therefore, surface land-use and management practices have a direct impact on the water quality of the cave streams and their unique ecology. Streams within the watershed have also been shown to have fecal coliform levels in excess of current whole body contact standards. Without proper education and planning, development in the watershed will degrade the water quality of streams n the watershed. This project will build upon the planning foundation developed under previous AgNPS SALT and 319 projects.

PROJECT DESCRIPTION

During the first phase, the Southern Boone County Karst Team will update the watershed management plan by collecting data from previous 319 and salt projects, reviewing the data, and adding current water quality data. Additionally, a sub-watershed sensitivity analysis will be included in the watershed management plan. This data will be used during the second phase of the project to focus efforts on septic demonstrations, and conservation development BMP's. The first phase will also include education and outreach. Some of these efforts include website development, photo journals, newsletters and news releases, as well as presentations to local organizations, schools, and planning boards. To accomplish these objectives, the commission plans to hire a full-time urban conservationist, and form steering, policy and advisory committees.

OBJECTIVES

1. To reduce watershed degradation from future urbanization by providing technical and financial assistance to developers, builders, and property owners to encourage adoption of BMPs, through public meetings and training seminars.
2. To provide elected officials with scientifically based land-use policies through the formation of policy and citizen advisory committees.
3. To conduct monitoring of current watershed water quality conditions at 10 sites within the watershed and monitor the pollution reducing impacts of installed BMPs.
4. To provide access to stream monitoring data, research results and project information to watershed residents by the use of newsletters, website, and presentations.

PRODUCTS

- ✓ Update of WQMP
- ✓ Watershed Sensitivity Analysis
- ✓ QAPP
- ✓ Website
- ✓ GIS
- ✓ Watershed Database
- ✓ Handouts
- ✓ Powerpoint Presentations
- ✓ Photo Journal
- ✓ Press Releases
- ✓ Newsletters
- ✓ Cave Mapping and restoration
- ✓ Watershed Forum
- ✓ Dye Tracing Study
- ✓ Quarterly and Final Reports

Sponsor: Boone County Commission

Cooperators: MDNR, MDC, USDA-ARS, DHSS, UMC, Boone County Soil and Water Conservation District, Boone County Planning and Building Inspection City of Columbia Planning and Zoning Department

Contact: Bill Florea

Boone County Commission
801 E. Walnut
Columbia, MO 65201-7730
(573)-886-4330

Valley Mill Lake and Watershed Restoration Project

The Valley Mill reservoir in northeast Springfield is part of the drinking water supply for the city of Springfield. The reservoir has become almost entirely silted in, and algae mats are common. The impacts of nonpoint source pollution are evident in the steambank erosion, increased sediment load, algae blooms, and sewage smell. The watershed contains several industrial complexes, a golf course, subdivisions, and the intersection of Hwy 65 and 44. The area is scheduled for increased urbanization.

PROJECT DESCRIPTION

Through this subgrant, the WCO will fund an environment assessment of the Valley Mill sub watershed. After the assessment, the WCO will target the areas of greatest sediment and nutrient contribution, and establish best management practices to reduce NPS pollution. WCO will then monitor the BMPs to determine their effectiveness. The WCO will also work with the city of Springfield to drain Valley Mill Lake, remove the sediments, and reinforce the dam. During the project, the WCO will introduce the education programs started in other sub watersheds. These include, but are not limited to, a kick-off dinner, earthday programs with school children, Show-Me Yards and Neighborhoods, and Business outreach activities sponsored by the Green County Choose Environmental Excellence Program. Finally, the WCO will plan and build a demonstration site for the community. Projects for the site include a trail, dock, wetland area, parking lot, and outdoor classroom. This will benefit the community by increased recreation, education, and watershed cohesiveness.

OBJECTIVES

1. Complete an environmental assessment of the pathways and amounts of nonpoint source pollution into the Valley Mill reservoir.
2. Develop a three stage educational program, targeting school children, businesses and landowners.
3. Restore Valley Mill reservoir and watershed
4. Create a demonstration site for the community, and
5. Create a monitoring program of the performance of restoration practices.

PRODUCTS

1. An environmental assessment of NPS pollution concentrations and pathways through the sub-watershed.
2. Area meeting will be held to disseminate information to watershed landowners, businesses, and public officials.
3. A demonstration site will be created with the construction of a dock, trails, parking facilities and an outdoor classroom.
4. Best management practices will be implemented based on the information and recommendations from the environmental assessment
5. A Quality Assurance Project Plan.

6. A final written report, including all water quality data, will be submitted to the department upon completion of the project.

Sponsor: Watershed Committee of the Ozarks, Inc

Cooperators: City Utilities of Springfield, Southwest Mo State University, Ozark Greenways, City of Springfield, Missouri Department of Conservation, and USDA

Contact: Watershed Committee of the Ozarks, Inc
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Springfield, MO 65806
Loring Bullard (417)-855-1127

Elk River/Shoal Creek Water Quality Restoration Project
The Elk River/Shoal Creek watersheds lie within McDonald, Newton, Barry, and a small portion of Lawrence County in the southwest corner of Missouri. Streams and rivers within these watersheds are public drinking water sources and are used heavily for floating, camping, and whole body contact recreation activities. The Elk River basin has 126.5 miles of stream segments impaired due to nutrients from nonpoint source pollution from livestock production. Shoal Creek has 13.5 miles of impaired streams due to fecal coliform from unknown agricultural sources. These watersheds have experienced an increase of about 15 percent in residential population this past decade and a rapid expansion in the poultry industry. This increase in poultry production has created serious concerns about the impact on the water quality due to land application of poultry waste. Currently in the Elk River Basin there are 31 Class I poultry facilities, 116 Class II, and 37 with operations smaller than Class II with Letters of Approval based on best management practices.

PROJECT DESCRIPTION
This project will implement best management practices which include: development and implementation of comprehensive nutrient management plans (CNMPs); transport of poultry litter out of the watersheds to areas of intensive crop production; construction of poultry litter stacking sheds; tarps to prevent runoff from stored litter; pH correction of soils on farms utilizing CNMPs; piloting of livestock watering wells with rotational grazing systems; and livestock exclusion from streams. This project will be coordinated with other 319 projects in the area for outreach and education that will focus on proper nutrient management of poultry and livestock wastes.

OBJECTIVES
1. To develop Comprehensive Nutrient Management Plans (CNMPs) on 100 farms (about 15,000 acres) to prevent overapplication of nitrogen and phosphorus to soils.
2. To record the amount of litter that is being applied according to CNMPs in the watershed.
3. To increase nutrient uptake on 6,000 acres under CNMPs by correcting soils with a pH below 5.8, thus reducing nutrient runoff.
4. To construct 24 manure storage sheds to enable proper timing of nutrient application and prevent uncovered outside storage of litter. This will allow approximately 326 tons of

nitrogen and 326 tons of phosphate per year in the litter to be managed properly so risk of runoff into waterbodies is reduced.

5. To reduce runoff from 100 tons of litter per tarp (10 tarps) so litter can be temporarily stored in close proximity to an area that is in need of the nutrients. This will aid in management of 2.5 tons of nitrogen and 2.5 tons of phosphate/tarp/use. The tarps will be used in a watershed not listed for nutrients on the 303d list.
6. To demonstrate the feasibility of transporting 3,200 tons of litter containing approximately 80 tons of nitrogen and 80 tons of phosphate out of the watershed.
7. To protect streams from sedimentation and fecal contamination from livestock on 20 farms or 5 miles of stream.
8. To construct wells to supply water for managed grazing systems when this is the least cost and most environmentally beneficial option for livestock drinking water.
9. To hire a project coordinator, technician, and clerk to accomplish the above objectives.
10. To contact landowners with current animal waste plans for review and update to CNMPs on 50 farms.
11. To promote the goals and successes of the Elk River/Shoal Creek Water Quality Restoration Project to the media and to the public through the current Elk River Water Quality Demonstration 319 Project.
12. To aid in quantification of the nutrient problem in the watershed through compilation of soil and litter analyses.
13. To provide progressive photographic documentation of all tasks listed in milestones. At minimum this would include photos of " before and after" installation of BMPs.

PRODUCTS

Expected products will include 150 comprehensive nutrient management plans; 24 manure storage sheds, pH correction on 6,000 acres; 10 litter storage tarps; feasibility study of litter transport to intensive crop production areas in need of nitrogen and phosphate fertilizers; 20 livestock watering wells in combination with rotational grazing systems; compilation of soil and litter analyses as an indicator of quantification of the nutrient problem in the watersheds; exclusion fencing on 5 miles of riparian corridor; and photographic documentation of all the tasks included in the milestones.

Sponsor: McDonald County Soil and Water Conservation District

Cooperators: Missouri Department of Natural Resources, USDA Natural Resources Conservation Service, Missouri Department of Conservation, the Southwest Missouri RC&D, Simmons Foods, Inc., Tyson Foods, Inc., Willow Brook Foods, Inc., MOARK Productions, Inc., Butterball Turkey Company, George's Inc., and the University of Missouri "Education/Information to Reduce Water Pollution and Increase Management Practices Utilized by Livestock and Poultry Producers in Southwest Missouri" 319 project.

Contact: McDonald County Soil and Water Conservation District
1900 South HWY. 71
Neosho, MO 64850
Lynn Jenkins, District Conservationist

(417) 451-1366, Ext. 3

Upper Reach Spring River 319 Project

The Lawrence County, Missouri, portion of the Upper Spring River Hydrologic unit is approximately 271,000 acres. The project area measures 130,598 acres and is composed of four, fourteen digit hydrologic units, and includes a small area in Barry County, Missouri. It is primarily agricultural with the dominant land use being pasture. Approximately 30 percent is forested. The watershed has a high density of poultry and cattle. Lawrence County ranks first in number of cattle in Missouri. Major tributaries in the Lawrence County portion of the Upper Spring River include upper reaches of the Upper White Oak Creek, Stahl Creek, Truitt Creek, Williams Creek, Honey creek, and Upper Center Creek. The cities of Aurora, Freistatt, Marionville, Miller, Mount Vernon, Stotts City, and Verona, Missouri are located in the basin.

There are 45 known dairy farms and 22 poultry facilities in the project area. The animal waste from these facilities poses a threat to the areas water resources, through runoff and through direct access by cattle to the streams.

PROJECT DESCRIPTION

A nutrient management specialist will be hired as the project manager to develop a formal nutrient management school curriculum. This curriculum will be implemented to educate producers in the project area. Area producers will also be involved in restoration projects for riparian buffers and wetlands, and will be educated on evaluating the condition of their streams. Financial assistance will be provided to the participants in the restoration activities and for those that construct animal waste facilities. Stream teams will collect data in selected locations during the project period. Field days and tours will demonstrate the best management practices used by the landowners that participate in this project.

OBJECTIVES

1. To develop and apply sound comprehensive nutrient management plans for livestock feeding operations in the project area.
2. To provide for restoration of riparian corridor.
3. To provide for restoration of wetlands.
4. To increase awareness and educate landowners and producers about ways to reduce nonpoint sources of pollution from entering the creeks and streams, through the use of best management practices.

PRODUCTS

A Quality Assurance Project Plan (QAPP) for testing and monitoring activities, three nutrient management schools, two new Stream Teams, 5 producers trained in the use of Stream Visual Assessment Protocol (SVAP), restoration of 25 acres of wetland, protection of 20 miles of riparian corridor, development and follow-up on 50 comprehensive nutrient management plans (CNMP) for producers, construction of 6 dairy waste management facilities and 10 poultry waste management facilities, 2 tours and 3 field days.

Sponsor: Lawrence County Soil and Water Conservation District

Cooperators: Missouri Department of Natural Resources, USDA Natural Resources Conservation Service, University of Missouri Outreach and Extension Service, Missouri Department of Conservation, Lawrence County Soil and Water Conservation District, Barry County Soil and Water Conservation District, Stream Teams, local livestock and dairy producers.

Contact: Lawrence County Soil and Water Conservation District
10733 Highway 39
Mt. Vernon, MO 65712
Paula Champion (417) 466-7687

North Fork Salt River Phase II: Implementation

The watershed of the North Fork of the Salt River covers 626 square miles or 400,640 acres and includes portions of the following six counties with a total population of 65,380: Adair (24,977), Macon (15,762), Monroe (9,311), Schuyler (4,170) and Shelby (6,799).

According to the United States Geological Survey (USGS), this eight-digit hydrologic unit 07110005 is made up of 44% row and close grown cropland, 42% cool season grassland, 11% forest and woodland, 1% open water and 2% other uses.

This watershed area is almost entirely in the Central Claypan Major Land Resource Area. Most of the area is a nearly level to gently sloping till plain, mantled with loess of variable thickness.

The North Fork of Mark Twain Lake is on the Missouri 1998 Section 303(d) List of Impaired Waters. Atrazine is the contaminant of concern. Other water quality concerns include high total organic carbon loads, high turbidity spikes after rainfall events and sedimentation in the lake. Since these are nonpoint source pollutants that are largely unregulated, these waters are not expected to attain established standards through currently required control technology. Without a water quality management plan, these watersheds are subject to total maximum daily load establishment.

North Fork Phase II follows a previous project worked with community leaders to develop tools and resources for watershed management issues. The effort focused on awareness of the water quality issues in the watershed and developing a model for these communities to use in developing their own management plan for the watershed. The target audience was be the community leaders in the North Fork Salt River watershed of the Mark Twain Lake and the CCWWC membership communities and counties. Among the many products resulting from this prior project was the development of a Watershed Resoration Action Strategy(WRAS). This WRAS identified areas of concern that need attention to make a difference in water quality in the watershed. North Fork Phase II will focus on those areas to demonstrate and implement BMP measures.

OBJECTIVES

Agriculture/Natural Resources Management: Install a model riparian buffer protection project on Crooked and Otter Creeks to reduce erosion and sediment loading and improve aquatic and terrestrial wildlife habitat; sponsor workshops to educate landowners/producers and natural resource professionals about Confined Animal Feeding Operations (CAFO's), lagoon

management, Certified Nutrient Management Plans (CNMP's) and riparian management systems.

Community/Watersheds: Establish a partnership with the U.S. Army Corps of Engineers (COE) at Mark Twain Lake to integrate a water festival into the on-going Environmental Education Day; sponsor a series of workshops for teachers on Projects WET, WILD, Learning Tree and the Leopold Education Project. The task force will work with an area University to secure college credits for these workshops.

Water/Wastewater: Assist a local unsewered community to find a solution to their wastewater problem; provide and sponsor a program to educate local government officials about Phase II Stormwater; and alternatives to meet future regulations.

PRODUCTS AND GOALS

Agriculture/Natural Resources Management

- 2500 feet of buffers and other structures to demonstrate effectiveness in limiting sedimentation and nutrient loading while improving aquatic and terrestrial wildlife habitat.

  Using existing models, the working group calculates the reduction of sedimentation and nutrient loading to be 75 – 95% depending on buffer system design and landscape characteristics.

- Two educational workshops/seminars and/or organized events such as a field day or tour to showcase solutions developed by working group.

  The goals are (1) to reach 75 landowners/producers with information on developing management plans related to CAFOs, lagoon management and CNMP, and (2) to reach area natural resource management professionals on the design, installation and maintenance of buffers and to seek their input on conferences for farmers and landowners on the benefits of buffer systems.

  50% of workshop participants will develop and implement management plans appropriate to their operation and 40 – 50 public and private natural resource professionals will have advanced training in buffer design, installation and maintenance that will translate into more flexible buffer designs that fit specific landscapes and landowner needs.

- A working partnership to extend beyond the life of this project.

Community/Watersheds

- Three environmental Education Days/Water Quality Festivals to involve 1000 children and 50 teachers and/or youth educators each year in the U.S. COE Environmental Education Day and University Outreach and Extension Water Festival.

The goal for this effort is that 25% of the school systems and/or youth groups in the watershed will carry out community service projects targeting nonpoint source pollution over the life of the project.

- Series of three workshops for teachers/youth educators to reach 100 educators with information on Projects WET, WILD, Learning Tree and the Leopold EducationalProject. The task force will work with an area University to secure college credits for these workshops. It is expected that 60% of the participating educators will integrate some or all of the curriculum material into their classroom teaching.

- A working partnership to extend beyond the life of this project.

Water/Wastewater

- Assist a local unsewered community to find a solution to their wastewater problem. This effort will include the formation of one working citizen's committee from the target community, development of a strategy for meeting wastewater needs in one community and one manual for use by unsewered communities with similar problems.

  Expected results are that the unsewered community will find a solution to their wastewater problem and the knowledge gained will be transferable to other unsewered communities.

- Sponsor workshop(s) on Phase II Stormwater regulations with the result that 75% of the counties and municipalities represented will become well versed on Phase II Stormwater Regulations and how they affect their entity.

- A working partnership to extend beyond the life of this project.

Education/Information: The North Fork Project personnel will be responsible for:

- One brochure describing the North Fork Project, WAC and working groups by issue areas.

- Nine media releases to publicize WAC and/or working group accomplishments.

- 12 quarterly Downstream newsletters to feature project information and accomplishments and provide educational information to stakeholders.

- Ten educational/informational events including workshops and/or regional watershed conferences.

- Working partnerships to extend beyond the life of this project.

Sponsor: Clarence Cannon Wholesale Water Commission

Cooperators:Mark Twain Regional Planning Commission, Missouri Department of Health, NRCS, Mark Twain Water Quality Initiative, Department of Natural Resources, Missouri Corn

Growers, University of Missouri Outreach and Extension Service, Soil and Water Conservation Districts, local county commissions, local communities**.**

Contact: Clarence Cannon Wholesale Water Commission
34146 Route U
Stoutsville, Mo 65283
Liz Grove, General Manager 573-672-3221

Pilot Agricultural Nonpoint Source SALT Projects

The Soil and Water Districts Commission makes available the Special Area Land Treatment (SALT) program to districts to address nonpoint source pollution issues associated with runoff from production agriculture. The SALT program is a locally led, watershed based program that allows Soil and Water Conservation Districts to target technical and financial assistance to landowners in priority watersheds for the purpose of conserving and protecting Missouri's soil and water resources.

The concept of the AgNPS SALT projects is to provide a basic level of resources to soil and water conservation districts and landowners so significant reduction and control of nonpoint source pollution can be accomplished in a targeted watershed through voluntary means. These projects are based on numerous partners contributing to a project and various tools being utilized to accomplish project goals. Through cooperative efforts, available resources and funding can be used to address nonpoint source water quality issues in Missouri.

AgNPS SALT projects are located in fifty different watersheds throughout the state as shown on the map. Boundaries of these projects are based on hydrologic units or complete topographic watersheds. Some of the projects cross county lines and are cooperatively supported by two or more local soil and water conservation districts. Watersheds range in size from approximately 17,000 acres to 99,000 acres.

AgNPS SALT projects propose to reduce or prevent agricultural nonpoint source water pollution through total resource management and adoption of recognized Best Management Practices (BMPs). The projects propose to address water quality issues by reducing chemical and nutrient runoff from cropland, improve pasture management, reduce sedimentation from agricultural land, protect and enhance riparian corridors, improve animal waste management and utilization, reduce runoff from irrigated cropland and increase awareness and understanding of agricultural nonpoint source water quality issues.

Partnerships and local leadership are key components of these voluntary projects. Some partners assisting local soil and water conservation district in development and implementation of pilot AgNPS SALT projects include local farmers, city and county governments, local agribusiness and commodity organizations, recreational organizations, volunteer stream teams, private corporations and foundations, city utilities and water districts, Missouri Department of Natural Resources, Department of Conservation, Department of Agriculture, University of Missouri and Extension Outreach, USDA Natural Resources Conservation Service, and the US EPA.

<u>Overview of the Agricultural Nonpoint Source Special Area Land Treatment Projects</u>
<u>(AgNPS SALT)</u>

Barry County Soil & Water Conservation District (SWCD); UPPER SHOAL CREEK WATERSHED
This watershed area is approximately 92,000 acres with an estimated 73% grassland, 20% in forestland, 2% cropland, and 5% other. Increasing volume and improper disposal of animal waste are the greatest threat to this watershed. Another source of nonpoint pollutants is septic systems. Inadequate sewage treatment along with abandoned wells and cisterns result in effluent and contaminants entering surface or groundwater. Concerns have been expressed regarding erosion from overgrazing and poorly managed pastures. Objectives include:

1) educating and training landowners in nutrient management;
2) assisting landowners in the project area with the establishment of nutrient management systems;
3) improving existing or establish riparian corridor;
4) establishing baseline levels of nitrogen and phosphorus in streams and springs;
5) promoting the planting of grass species that more efficiently utilize nutrients;
6) increasing efficiency of nutrient use through demonstration of new litter-handling practices;
7) establishing baseline levels & determine safe levels of soil test phosphorus; and
8) increasing knowledge of pollution prevention.

Project support includes organizations, agencies and companies such as Missouri Department of Conservation (MDC), Natural Resources Conservation Service (NRCS), University of Missouri Extension, Tyson Foods, and Stream Team volunteers.

Bates County SWCD; MIAMI CREEK/DREXEL LAKE
The Miami Creek/ Drexel Lake project encompasses 80,000 acres of land, including the Butler Municipal Reservoir, Miami Creek and Drexel Reservoirs. These reservoirs supply drinking water to the cities of Butler, Drexel, Amsterdam and four public rural water supply districts serving approximately 8,500 Bates County residents. Excessive chemical, nutrient and animal wastes are problems in the reservoirs' surface and ground water tributaries. The overall goal of the pilot project is to reduce the amount of nonpoint source contaminants (Atrazine, phosphorus, and fecal coliform bacteria) from reaching the tributaries and reservoirs of the Miami Creek and Drexel Lake watersheds. The objectives include:

1) developing a public and landowner awareness of AgNPS pollution;
2) improving water quality by reducing runoff of commercial chemicals and nutrients by implementing Best Management Practices (BMPs);
3) reducing animal waste and associated nutrient runoff through the implementation of BMPs; and
4) improving the public water supply by reducing sediment load through the implementation of BMPs.

A total resource management approach will be used to protect water quality in the watershed. Cost-share and other financial incentives will be used to encourage adoption of BMPs and the application of Resource Management Systems.

Boone County SWCD; BONNE FEMME and LITTLE BONNE FEMME CREEKS

This 58,876-acre project is made up of two watersheds which drain into the Missouri River. Land cover in the watershed includes 18,068 acres of grassland, 17,787 acres of cropland, 20,035 acres of forest, and 2,968 acres of other cover. Livestock waste, herbicides, fertilizers, sediments, and stormwater runoff are major nonpoint source problems associated with agriculture in the watersheds. Poor pastures, grazing in wooded areas and around sinkholes, barnyard feedlots, streambeds accessible to livestock and row crop fields are critical sources for these contaminants. Goals for this project include: restoring riparian areas, streambanks, and small wetlands, improving invertebrate indicators of stream health in the watersheds, and reducing fecal coliform bacteria, nitrate, and pesticide contamination of streams in the watersheds. Objectives include:

1) adoption of Best Management Practices (BMPs) for riparian corridor improvement and management along 4.5 miles of stream;
2) adoption of BMPs that reduce fecal coliform bacteria, nutrients, pesticides, stormwater and/or sediment runoff from grazing land, cropland, and feedlots; and
3) adoption of water quality monitoring by farmers in the watersheds.

Educational activities will be designed to educate landowners, encourage adoption of BMPs and promote participation in cost-share. Project support includes organizations and agencies such as MDC, NRCS, Show-Me Clean Streams, County Health Department, and local schools.

Carroll County SWCD; TURKEY CREEK WATERSHED Protection Project

This watershed totals 62,000 acres, including 28,950 acres of cropland, 23,887 acres of grassland (includes acres enrolled in the federal Conservation Reserve Program), 9,869 acres of timber, and 97 acres of streams, ponds and wetlands. Water resources are primarily used for recreation, livestock watering, and for fish/wildlife use and habitat. Excessive herbicide, pesticide, nitrogen, phosphorus, and sediment are contributed to streams in the watershed. Several livestock operations need waste management systems and/or assistance in order to limit livestock access to streams and ponds. Water quality problems associated with row crop operations could result from the not using Best Management Practices, which, if implemented, would reduce heavy silt load contributions to Turkey Creek. Farming up to the edge of the stream banks also results in severe erosion. The overall goals of the project are to reduce sedimentation and improve water quality in Turkey Creek and its tributaries. The objectives include:

1) treating 75% of the CRP release ground with no-till farming;
2) improving waste treatment and handling facilities of each livestock operation in order to meet DNR standards;
3) having 60% of the crop producers using Integrated Crop Management (ICM) techniques meeting NRCS Standards and Specifications;
4) treating sheet and rill erosion on 60% of cropland to reach “tolerable soil loss” (“T”) levels,

5) treating 270 acres of gully erosion; and
6) informing and educating 95% of landowners in the project area about BMPs.

Cost-Share incentives may be available to producers who develop and implement plans to improve water quality. In addition, incentives may be offered to producers who use scouting and ICM techniques to properly apply correct amounts of chemicals. Other partners include NRCS, University of Missouri Extension, Ray-Carroll Cooperative, Lexington M.F.A., Conservation Technology Information Center (CTIC), and a Stream Team.

Dekalb County SWCD; CAMERON WATERSHED

The Cameron watershed, which consists of 16,671 acres of land, drains into the four public reservoirs supplying drinking water to approximately 10,000 people, including the City of Cameron, and two correctional centers. Land in the watershed is primarily grassland, or cropland. Complementary projects have previously been conducted to identify and address water quality issues in the watershed. These include an Environmental Protection Agency (EPA) Clean Lakes grant, U.S. Department of Agriculture (USDA) Water Quality Incentive Program project, a computer modeling project conducted by the Food and Agricultural Policy Research Institute (FAPRI), and an EPA 319 minigrant. The most significant issue in the watershed is the threat that Atrazine levels in water will exceed state drinking water standards. The primary objective of the project is to reduce agricultural nonpoint source pollutants to acceptable Department of Natural Resources' standards in untreated water by the year 2006. Major goals of the project are to:

1) lower the use of Atrazine to 50% of label rate on 6,000 acres of cropland;
2) reduce nutrient and sediment delivery to the reservoirs; and
3) provide assistance developing Integrated Crop Management (ICM) plans to landowners in the watershed.

Financial incentives will be offered through multi-year agreements to reduce use of Atrazine on corn and grain sorghum cropland.

Greene County SWCD; UPPER LITTLE SAC CREEK

This project is made up of two watersheds totaling 44,954 acres. In addition to 100 miles of streams, the watershed also includes Fulbright Springs and McDaniel Lakes, which provide public drinking water to the city of Springfield. Land use in the watershed is estimated to be 59% grassland, 23% woodland, 3% reservoirs, and 14% other uses. Concerns in the watershed include increased urban growth, stormwater runoff, nonpoint pollutants resulting from poor land management practices, and contamination of groundwater via septic systems, sinkholes and abandoned wells. The goal of the project is to protect and maintain the quality of all drinking water resources while enhancing economic sustainability for agricultural producers through education and improved land management practices. Objectives include:

1) improving and/or maintaining water quality and quantity;
2) preventing stormwater runoff and soil erosion;
3) improving groundwater quality;

4) improving quality and management of grassland and timber; and
5) providing public information and education.

Project support and technical assistance will be provided from a variety of agencies and organizations such as NRCS, MDC, University of Missouri Extension, City of Springfield utility companies, Southwest Missouri State University, and Stream Team volunteers.

Harrison County SWCD; SUGAR CREEK

The Sugar Creek watershed consists of 68,630 acres of land located in the Grand River Basin of northwest Missouri. The principal concern of the watershed is degradation of stream habitat and water quality within this unique, high-quality prairie stream. Factors threatening Sugar Creek include sedimentation, nutrient pollution from livestock manure and fertilizer, riparian area deforestation and agricultural pesticides. There are 10,950 acres of land needing treatment including 6,900 acres of cropland and 3,300 acres of grassland. The Topeka Shiner, a member of the minnow family and candidate for listing as "endangered" by the U.S. Fish & Wildlife Service, is found in this watershed and is experiencing a population decline. Goals of the project include:

1) improving water quality through establishment and maintenance of riparian buffers;
2) achieving soil conservation on 70% of agricultural land by reducing erosion and adoption of nutrient and pesticide management;
3) improving management and marketing of grass and timber; and
4) gaining support of landowners, farm operators, youth and community organizations for the project.

Cost-share and financial incentives will be offered to encourage adoption of Best Management Practices. Project funding is requested from various state and federal agencies including the Missouri Department of Natural Resources (DNR), Missouri Department of Conservation, United States Department of Agriculture's Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Program.

Laclede County SWCD; BRUSH CREEK ANIMAL IMPACT STUDY

The Brush Creek watershed consists of 27,071 acres of land all located in Laclede County. The primary water quality issue is the overloading of nutrients resulting from runoff laden with sediments and animal waste. Imperiled aquatic species, such as the Bluestripe Darter and the Least Darter, are found within the larger Osage Fork watershed. Goals of the project include:

1) improving pastureland through development of livestock water, control of undesirable vegetation, and enhancement of plant diversity;
2) reducing runoff velocity and increasing filtration on pasture land;
3) containment and application of concentrated effluent produced by small to medium dairy operations; and
4) improving riparian corridor management.

Cost-share and financial incentives will be offered to encourage adoption of Best Management Practices. Funding is requested from various state and federal agencies including DNR, MDC, and from USDA's Environmental Quality Incentives Program (EQIP). A 319 project is underway in the larger Osage Fork of the Gasconade watershed, which includes the Brush Creek watershed. Demonstrations and educational activities in the 319 project complement goals of the Brush Creek project.

Osage County SWCD; LOOSE CREEK WATERSHED

This 58,000-acre watershed includes communities of Linn, Loose Creek, Luystown, and Frankenstein. The watershed is comprised of approximately 53% forest, 42% grassland, 4% cropland, and 1% urban. Livestock production is the major agricultural enterprise in the watershed, with 31 swine and 18 turkey operators. Soil tests indicate that elevated nutrient levels exist in and adjacent to confined livestock operations, particularly turkey farms. This project aims to encourage operators to spread manure as fertilizer on available acres within the watershed according to a waste management plan in order to prevent nutrient buildup in any one area. Other nonpoint pollution concerns include accumulation of heavy metals in soils, nutrient buildup in soils, and economics of nutrient management. The overall goal of the project is to reduce the amount of nonpoint source contaminants (nitrogen and phosphorus) through utilization of non-structural Best Management Practices (BMPs). Objectives of the project are to:

1) develop a public and landowner awareness of nonpoint source pollution;
2) implement animal nutrient management plans and associated non-structural BMPs;
3) increase awareness and use of new application technology dealing with animal nutrient application;
4) offer cost-share practices and incentives to producers to accelerate adoption of nutrient management plans and associated BMPs; and
5) maintain a water quality-monitoring program to establish baseline information and track improvement to water quality.

This project complements an existing EPA 319 Nonpoint Source demonstration and education project addressing animal waste management issues. Partners in the project include local business and organizations, University of Missouri, and various state and federal agencies.

Randolph County SWCD; SILVER CREEK

This 30,700-acre watershed is a tributary of the East Fork Chariton River. Land use in the watershed is estimated to be 29% cropland, 24% woodland, 21% pastureland and 26% other. The most visible source of water quality degradation is sedimentation, which results from sheet, rill, and gully erosion on cropland, and gully erosion on pastureland. The ultimate goal of this six-year project is to educate residents so they recognize and meet their needs with limited outside assistance. Objectives of the project include:

1) educating and inform residents about water quality through demonstrations, newsletters, field days and one-on-one assistance;
2) providing information on timber management;

3) assisting landowners in improving pasture management;
4) protecting and improving riparian areas;
5) controlling and preventing sheet, rill, and gully erosion;
6) improving pesticide and nutrient management; and
7) improving disposal methods of farm and household waste.

Limited financial assistance will be used for specific needs.

Saline County SWCD; COW CREEK Water Quality Project

The Cow Creek watershed contains approximately 20,405 acres, 15,444 of which are highly erodible cropland. As a result, improvements in management of this cropland will be given the highest priority. Although pesticide and nutrient leaching and runoff are the main concerns, gully erosion, animal waste management, and streambank erosion will also be addressed. Incentives will be offered to producers who use Integrated Crop Management (ICM) techniques to apply correct amounts of chemicals. Producers will be encouraged to develop Total Resource Management plans that include Best Management Practices for livestock waste management, the proper use and application of pesticide and fertilizers, and the installation of erosion control practices to reduce sedimentation. Objectives for this project are to:

1) develop and implement 91 total resource plans;
2) have 10,750 acres at or below tolerable soil loss ("T") levels;
3) develop 36 Total Resource Management plans with a forage legume in the rotation;
4) reduce gully erosion on crop and pasture to no more than one ton of soil loss per acre per year;
5) develop and implement approved grazing plans on 30% of pasture land;
6) establish or improve existing riparian corridor along 10 miles of stream;
7) use a reduced amount, or non-residual, herbicide on 5,000 acres of cropland;
8) educate 70% of operators on water quality issues; and
9) test 100 private drinking sources for water quality.

Stoddard County SWCD; CYPRESS DITCH

This 99,700-acre watershed contains 67,000 acres of cropland. The cropland is divided into upland areas containing over 23,000 acres of highly erodible land and 44,000 acres of fertile flatland. In addition to cropland, the watershed contains 11,000 acres of woodland, 7,597 acres of land enrolled in the federal Conservation Reserve Program, 5,500 acres of pasture, and 8,603 acres of other land use. The primary concern in the project area is pesticide and nutrient movement from agricultural lands to surface water systems, streams, and aquifers. The goals of the project are improve the quality of surface water, evaluate surface water quality after Best Management Practices (BMP) have been applied, and increase the public's awareness of the environmental and economic benefits of water quality BMPs. Objectives include:

1) improving the water quality in Cypress Ditch;
2) treating 75% of the project area's irrigated cropland and 20% of the area's non-irrigated cropland with water quality BMPs;
3) reducing pesticide and nutrients in surface water;
4) participating in the Missouri Department of Natural Resources volunteer stream monitoring program, Stream Teams;

5) monitoring the quality of surface water in the project area;
6) evaluating effectiveness of water quality BMPs and surface water quality;
7) evaluating benefit and cost of water quality BMPs to determine economic impacts; and
8) conducting educational and informational activities.

Cooper County Soil and Water Conservation District (SWCD):
UPPER PETITE SALINE CREEK WATERSHED

Beginning date: January 1, 2001	Completion date: December 31, 2007
Watershed Size: 50,146 acres	Project Length: 7 years
Total Budget: $750,000	

Land Use in the Watershed:	Pasture/Hayland/CRP	49.1%
	Cropland	39.25%
	Woodland	11.5%
	Riparian corridor in trees	91 miles

Objectives of the AgNPS SALT project include:
1. decreasing the amount of sediment/nutrient load by developing and implementing Total Resources Management plans;
2. promoting proper waste management;
3. establishing riparian corridors or filter strips;
4. installing streambank stabilization practices;
5. providing public information and education.

Project support includes: Morgan Co. SWCD, FSA, NRCS, Cooper County Commission, MDC, Moniteau Co. SWCD, various local agri-businesses.

Greene County SWCD: MIDDLE LITTLE SAC RIVER WATERSHED

Beginning date: January 1, 2001	Completion date: December 31, 2006
Watershed Size: 71,942 acres	Project Length: 7 years
Total Budget: $705,500	303(d) listed – agriculture - nutrients

Land Use in the Watershed:	Agricultural	50%
	Woodland (Privately owned)	40%
	Riparian Corridor	5%
	Urban	5%

Objectives of the AgNPS SALT project include:
1. improving and/or maintaining ground and surface water quality and quantity;
2. improving and/or maintaining pasture and grassland health;
3. improving and/or maintaining woodland health;
4. establishing and/or improving existing riparian corridor along the streams and rivers in the watershed;

5. providing public information and education support.

Project support includes: Polk County SWCD, NRCS, University Outreach & Extension, MDC, Watershed Committee of the Ozarks, Southwest Missouri State University, local stream team, Springfield City Utilities.

Holt County SWCD: SQUAW CREEK PARTNERSHIP FOR CLEAN STREAMS

Beginning date: January 1, 2001	Completion date: December 31, 2005
Watershed Size: 40,130 acres	Project Length: 5 years
Total Budget: $750,000	UWA listed – agriculture - sediment

Land Use in the Watershed:	Cultivated Cropland	70%
	Pasture	13.9%
	Woodland	8.9%
	Other	3.9%
	Non-cultivated Cropland	2.5%
	Public Land (MDC)	.08%

Objectives of the AgNPS SALT project include:
1. reducing sedimentation from runoff;
2. reducing herbicide/pesticide contamination and reduction of nutrient loads in the Squaw Creek tributaries.

Project support includes: Atchison County SWCD, Nodaway County SWCD, NRCS, University Outreach and Extension, United States Geological Survey, US Fish and Wildlife Service, MDC, Missouri Corn Growers Association.

Montgomery County SWCD: ELKHORN CREEK WATERSHED

Beginning date: January 1, 2001	Completion date: December 31, 2007
Watershed Size: 62,830 acres	Project Length: 7 years
Total Budget: $700,000	303(d) listed – agriculture - sediment

Land Use within Watershed:	Crop Production	67%
	Woodland	13%
	Pasture/Hayland	12.6%
	Riparian Corridor	2.3%
	Urban Development	2.3%
	Roads/Farmsteads	2%

Objectives of the AgNPS SALT project include:
1. holding information and education meetings to make landowners and producers aware of the problems and what they can do to help;
2. conducting tours and field days to demonstrate practices that are currently being used and to encourage their use in more locations;
3. providing incentives to encourage landowners and producers to install practices as part of a total resource management plan;

4. making producers and landowners aware of what programs are currently available and what programs will be available through the AgNPS SALT through information and education meetings, field days, newsletter and newspaper articles;
5. bringing partner agencies together to provided technical assistance toward our common goal;
6. provide clerical, managerial, and technical assistance to achieve the goal.

Project support includes: University Outreach and Extension, NRCS, FSA, MDC, Loutre Quail Unlimited, Mid-Missouri Chapter Ruffed Grouse Society.

Stone County SWCD: SPRING CREEK WATERSHED

Beginning date: January 1, 2001 Completion date: December 31, 2007
Watershed Size: 27,860 acres Project Length: 7 years
Total Budget: $750,000

Land Use in the Watershed:	Pasture/hayland	55%
	Woodland	31%
	Urban/roads	11%
	Cropland	3%
	Riparian corridor	16 miles

Objectives of the AgNPS SALT project include:
1. decreasing sediment and nutrient loading by implementing total resource management plans;
2. promoting proper waste management to reduce pesticides, nutrients, and fecal contamination;
3. establishing and/or improving riparian corridors by fencing livestock from streams;
4. providing tours and workshops to educate and encourage better management and showcase the practices being established in the watershed.

Project support includes: Christian County SWCD, Stone County Commission, James River Basin 319 Project, University Outreach and Extension, Crane Chronicle, NRCS, Southwest Missouri RC & D, State Representative Judy Berkstresser, Reeds Spring School, Hurley School, MDC, Earth Team Volunteer Program

Benton County SWCD: DEER CREEK WATERSHED

Beginning date: July 1, 2001 Completion date: June 30, 2008
Watershed Size: 46,606 acres Project Length: 7 years
Total Budget: $750,000

Land Use in the Watershed:	Pasture	40%
	Woodland	35%
	Hayland	10%
	FORBES Dev.	10%
	Riparian Corridor	5%

Objectives of the AgNPS SALT project include:
1. conducting educational and informational activities to develop an awareness of non-

point source pollution;
2. applying intensive grazing systems at a progressive rate;
3. establish Best Management Practices;
4. implement animal nutrient management plans;
5. alternative watering supplies;
6. install riparian buffers.

Project support includes: Benton Co. SWCD, Camden Co. SWCD, Hickory Co. SWCD, MDC, NRCS, FSA, Extension, Benton Co. Commission, Benton Co. Cattlemen's Assn., FORBES Lake of the Ozark Management Assn.

Dallas County SWCD: LINDLEY CREEK WATERSHED

Beginning date: July 1, 2001 | Completion date: June 30, 2008
Watershed size: 41,165 acres | Project length: 7 years
Total Budget: $750,000

Land Use in the Watershed:		
	Pasture/Hayland	57%
	Woodland	40%
	Cropland	2%
	Urban	1%

Objectives of the AgNPS SALT project include:
1. decrease the amount of erosin on croplands with permanent vegetative cover;
2. promote nutrient management and manure transfer;
3. promote livestock exclusion, planned and prescribed grazing systems;
4. establish alternate watering systems;
5. promote well decommissioning.

Project support includes: Dallas Co. SWCD, Polk Co. SWCD, NRCS, FSA, MDC, DNR, Extension.

Boone County SWCD: UPPER HINKSON CREEK

Beginning date: July 1, 2001 | Completion date: June 30, 2008
Watershed Size: 32,918 | Project Length: 7 years
Total Budget: $464,075

Land Use in the Watershed:		
	Cropland	18%
	Grassland	42%
	Woodland	19%
	Urban	20%

Objectives of the AgNPS SALT project include:
1. restore riparian areas along stream banks and small wetlands;
2. reduce sedimentation in streams, ponds and wetlands;
3. reduce coliform, nitrate, and pesticide contamination of streams, ponds and wetlands.

Project supports includes: Boone Co. SWCD, NRCS, MDC, DNR, Extension, Boone Co. Commission.

Scott County SWCD: NORTH CUT

Beginning date: July 1, 2001 Completion date: June 30, 2008
Watershed Size: 65,065 Project Length: 7 years
Total Budget: $750,000

Land Use in the Watershed:	Cropland	90%
	Grassland	5%
	Woodland	4%
	Urban	1%

Objectives of the AgNPS SALT project include:
1. establish conservation buffers on cropland;
2. reduce over – application of irrigation water by improving system efficiencies;
3. assist with nutrient/pesticide management systems and irrigation water management systems.

Project support includes: Scott Co. SWCD, St. Johns Bayou Drainage District, MDC, NRCS, MU – Agroforestry, Extension, FSA, WESTVACO Fiber Products, Scott Co. Commission, Bootheel Resource Conservation and Development Council, local business and schools.

Cape Girardeau County Soil and Water Conservation District (SWCD):
HUBBLE CREEK WATERSHED

Beginning date: July 1, 2001 Completion date: June 30, 2007
Watershed Size: 44,875 acres Project Length: 6 years
Total Budget: $750,000

Land Use in the Watershed:	Pasture/Hayland	38%
	Cropland	33%
	Forestland	12%
	Urban	12%
	Rural	5%

Objectives of the AgNPS SALT project include:

6. To reduce erosion on highly erodible soil units.
7. Decrease the amount of sediment and nutrients entering the streams by developing and implementing total resource conservation plans within the targeted watershed.
8. Using educational programs, tours, and demonstration projects to encourage participation of landowners within the Hubble Creek watershed.
9. To introduce both new and current beneficial management practices, and encourage total resources conservation management planning.

10. To use financial incentives by use of cost-share programs to encourage Best Management Practices (BMP) including: Riparian Forest Buffers, Planned Grazing Systems, Critical Area Planting and Tree and Shrub Establishment.

Project support includes: Cape Girardeau County Commission, UOE, MDC, DNR, NRCS, FSA.

Moniteau County Soil and Water Conservation District (SWCD):

NORTH MOREAU CREEK WATERSHED

Beginning date: July 1, 2001	Completion date: June 30, 2008
Watershed Size: 44,815 acres	Project Length: 7 years
Total Budget: $750,000	303(d) list – municipal – waste water

Land Use in the Watershed:	Pasture/Hayland	49%
	Cropland	35%
	Forest/Wasteland	8%
	Urban	3%
	Highway/Roads	2%
	Farmsteads	2%
	Riparian Corridors	132 miles

Objectives of the AgNPS SALT project include:

1. Decrease the amount of sediment, nutrient, and pesticide load levels entering the stream by implementing Resource Management System on 5,000 acres, plus another 10,000 acres planned to T or below.
2. Promote proper waste management facilities so as to reduce the amount of nutrient and fecal contamination by implementing Nutrient Management Plans and Waste Utilization Plans on an additional 2,5000 acres not covered under RMS planning.
3. Establish or improve 240 acres of riparian corridors or filter strips along 20 miles of the stream adjacent to crop fields since these corridors are the most effective means of trapping sediment, nutrients, and pesticides.
4. Install stream bank stabilization practices on at least 15 critical sites along the stream.
5. Conduct at least two workshops or tours annually to promote or showcase the practices being established in the watershed.

Project support includes: MDC, NRCS, FSA, DNR, Morgan County SWCD, Cooper County SWCD.

Pemiscot County Soil and Water Conservation District (SWCD):

PEMISCOT BAYOU WATERSHED

Beginning date: July 1, 2001	Completion date: June 30, 2007
Watershed Size: 46,490 acres	Project Length: 6 years
Total Budget: $750,000	

Land Use in the Watershed:	Cropland	90%

Grassland	6%
Woodland	2%
Open Water	1.5%
Swamp/Marsh	0.5%

Objectives of the AgNPS SALT project include:

1. Use Residue Management to save approximately 26,000 tons of soil per year on 13,000 acres of the conventionally tilled cropland from sheet-rill and wind erosion.
2. Pland 375 acres of grass filter strips along field edges and riparian corridors to benefit 15,000 acres, reducing sedimentation and subsequently creating wildlife habitat.
3. Plant 80 acres of windbreaks to protect 1,000 acres of cropland and riparian corridors.
4. Apply nutrient and pest management techniques, according to ICM, on 13,000 acres of cropland.
5. Stop excessive gully erosion adjacent to the Pemiscot Bayou by installing structures.
6. Increase irrigation efficiency on 2,000 acres of furrow irrigated cropland.

Project support includes: NRCS, Missouri Bootheel Partners Program – Cropland Flooding Program, stream team, MDC, Caruthersville High School, Cooter High School, Delta C-7, Hayti High School, South Pemiscot High School, Southeast Missouri RD&C, Ag Distributors, Helena Chemical Company, Consolidated Public Water Supply District #1, FSA, UOE, Delta Research Center, Southern Telecommunications Center.

Pettis County Soil and Water Conservation District (SWCD):

CAMP BRANCH AND BASIN FORK WATERSHED

Beginning date: July 1, 2001 Completion date: June 30, 2008
Watershed Size: 28,750 acres Project Length: 7years
Total Budget: $680,000

Land Use in the Watershed:		
	Pasture/Hayland	45%
	Cropland	40%
	Woodland	10%
	Urban	5%

Objectives of the AgNPS SALT project include:

1. Establish or enhance 23 miles of buffers along streams in the watershed adjoining agricultural land.
2. Reduce nutrient/sediment-loading levels on Camp Branch and Basin Fork creeks and their tributaries by establishing BMPs on 15,625 acres in the watershed.
3. Improve or create wildlife habitat in the watershed for species such as the prairie chicken by planting appropriate vegetation, maintaining existing plant cover, and by promoting the natural establishment of desirable plants such as native warm season grasses and wildlife-friendly cool season grasses.
4. Improve grassland conditions in the watershed by establishing BMPs on 7000 acres of grassland.

Project support includes: MDC, DNR, NRCS, UOE, Tyson Foods, Pettis County Commission.

Polk County Soil and Water Conservation District (SWCD):

BEAR CREEK WATERSHED

Beginning date: July 1, 2001 — Completion date: June 30, 2008

Watershed Size: 40,722 acres — Project Length: 7 years

Total Budget: $750,000

Land Use in the Watershed:		
	Pasture/Hayland	72%
	Cropland	4%
	Forestland	23%
	Urban	1%

Objectives of the AgNPS SALT project include:
1. Inform and educate 90% of landowners in the project area about Best Management Practices.
2. Restore riparian corridor/livestock exclusion from streams and woodlands.
3. Organize 2 volunteer stream teams to survey macro invertebrates on a semi-annual basis to establish both baseline and project improvements in water quality.
4. To involve schools and community organizations to insure our changes are long lasting and deep rooted in the community.
5. Improve quality and management of both grassland and timber.

Project support includes: Cedar County SWCD, DNR, MDC, NRCS, USFWS, UOE, FSA, Fair Play FFA, Bolivar FFA, Quail Unlimited.

Stoddard County Soil and Water Conservation District (SWCD):

JENKINS BASIN WATERSHED

Beginning date: July 1, 2001 — Completion date: June 30, 2007

Watershed Size: 46,195 acres — Project Length: 6 years

Total Budget: $750,000

Land Use in the Watershed:		
	Urban impervious	.1%
	Urban vegetated	.3%
	Row and close grown crops	73.0% *
	Cool season grassland	15.4%
	Deciduous forest/woodland	.1%
	Deciduous woodland	1.3%
	Deciduous forest	5.2%
	Bottomland hardwood forest	4.3%
	Swamp	0.0%
	Marsh/wet herbaceous vegetation	.1%

Open Water	.2%
*Furrow irrigated – Stoddard	25.2%
*Pivot irrigated – Stoddard	8.8%
*Furrow irrigated – Cape Girardeau	1.3%
*Pivot irrigated – Cape Girardeau	.3%

Objectives of the AgNPS SALT project include:
1. Protect and improve the quality of ground and surface water in the watershed through resource management plans.
2. Quantify the impact of the Jenkins Basin AgNPS SALT Project on surface and ground water quality.
3. Increase the public's awareness of the environmental and economic benefits of water quality BMPs.

Project support includes: MDC, NRCS, Stoddard County NRCS Irrigation Office, Dexter Field Office, University of Missouri - Columbia, Cape Girardeau SWCD, Southeast Missouri State University, Little River Drainage District, UOE.

Wright County Soil and Water Conservation District (SWCD):

WHETSTONE CREEK WATERSHED

Beginning date: July 1, 2001 Completion date: June 30, 2008
Watershed Size: 68,040 acres Project Length: 7 years
Total Budget: $750,000 303(d) listed – municipal – waste water

Land Use in the Watershed:		
	Woodland	48%
	Pasture/Hayland	45%
	Cropland	6%
	Riparian corridor	1%

Objectives of the AgNPS SALT project include:
1. Improve and/or maintain pasture and grassland health.
2. Establish and/or improve nutrient management systems.
3. Provide information and education support.
4. Establish and/or improve existing riparian corridor.
5. Improve and/or maintain woodland health.
6. Improve and/or maintain ground and surface water quality.
7. Increase technical assistance within the project area.

Project support includes: NRCS, MDC, FSA, Wright County Commission, UOE, Mountain Grove Wastewater Treatment Plant, Mountain Grove Bear Pack #50 - Stream Team #1190, Texas County SWCD, David Simpson - Stream Team #1506.

Carroll County Soil and Water Conservation District (SWCD):

McCROSKIE CREEK

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 43,744 acres Project Length: 7 years
Total Budget: $ 650,000

Land Use in the Watershed:		
	Cropland	56%
	Pasture	28%
	Hayland	9%
	Woodland	6%
	Other	1%
	Stream Miles	98 miles

Objectives of the AgNPS SALT project include:

11. provide information/education on best management practices,
12. advise landowners of new and different technologies,
13. address highly erodible cropland on 70% of the acreage eroding above 2T in the watershed utilizing many eligible AgNPS SALT practices, and
14. address water quality concerns on 12,450 acres of non-highly erodible land along streams and wetland areas.

Project support includes: NRCS, MDC, Ray County SWCD, Carroll County Commission, Norborne School Stream Team, Carrollton School FFA and area producers.

Hickory County SWCD: WEAUBLEU CREEK

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 39,308 acres Project Length: 7 years
Total Budget: $750,000

Land Use in the Watershed:		
	Cropland	15%
	Pasture	56%
	Hayland	1%
	Woodland	25%
	Urban	3%
	Stream Miles	75 miles

Objectives of the AgNPS SALT project include:

1. inform and educate 100% of the landowners in the watershed about best management practices,
2. restore and/or maintain 1,000 acres of native prairie,
3. restore and/or maintain ½ of the riparian corridor with livestock exclusion from streams,
4. organize a volunteer stream team through Weaubleau and Wheatland high schools,
5. publish a quarterly newsletter specifically for the SALT area,
6. organize a “Grazing Club” to give landowners the opportunity to discuss grazing systems, and

7. organize a Quails Unlimited Chapter and a National Wild Turkey Federation Chapter for the area.

Project support includes: Polk County SWCD, St. Clair County SWCD, MDC, NRCS, UOE, FSA, Quails Unlimited, National Wild Turkey Federation, USFWS, Weaubleau and Wheatland High Schools, Hickory County Commission, Hickory County Farm Bureau and Weaubleau MFA.

Mercer County SWCD: HONEY CREEK

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 64,500 acres Project Length: 7 years
Total Budget: $750,000

Land Use in the Watershed:	Cropland	53%
	Pasture	27%
	Hayland	7%
	Woodland	11%
	Other	2%
	Stream Miles	27 miles

Objectives of the AgNPS SALT project include:
1. reduce erosion and sedimentation in the Honey Creek watershed, and
2. improve nutrient, pest and animal waste management to a level that would remove the stream from the 303(d) list of impaired waters of Missouri.

Project support includes: Grundy County SWCD, Grundy County FSA, Mercer County FSA, Grundy County Commission, Mercer County Commission, MDC, UOE and NRCS.

Monroe County SWCD: BEE AND TURKEY CREEKS

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 22,806 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:	Cropland	55%
	Pasture	24%
	Hayland	8%
	Woodland	13%
	Stream Miles	39 miles

Objectives of the AgNPS SALT project include:
1. reduce erosion on crop fields to ‘T’ or below on 75% of cropland,
2. reduce sedimentation in Mark Twain Lake by stabilizing 12 miles of streams,
3. increase and improve the acres of riparian buffers along 12 miles of stream,
4. reduce the amount of atrazine, nutrients and pesticides in the watershed through implementation of 6,250 acres of pest and nutrient management practices, and
5. develop one waste management plan on an animal waste system.

Project support includes: MDC, NRCS and UOE.

Putnum County SWCD: BLACKBIRD CREEK

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 37,818 acres Project Length: 7 years
Total Budget: $750,000

Land Use in the Watershed:		
	Cropland	7%
	Pasture	34%
	Hayland	34%
	Woodland	14%
	Urban	4%
	Other	7%
	Stream Miles	27 miles

Objectives of the AgNPS SALT project include:

1. inform and educate 90% of the landowners in the watershed,
2. reduce the amount of sediment going into Lake Mahoney and Lake Thunderhead by 15%, and
3. reduce the amount of nutrients and pesticides going into our water sources by 10%.

Project support includes: City of Unionville, Blackbird Creek Cattle Company and Lake Thunderhead Wildflower Community.

Randolph County SWCD: DARK AND SUGAR CREEKS

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 44,467 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:		
	Cropland	42%
	Pasture	25%
	Hayland	9%
	Woodland	13%
	Urban	1%
	Public	1%
	Other	9%
	Stream Miles	35 miles

Objectives of the AgNPS SALT project include:

1. assist the City of Moberly in providing an adequate supply of water for drinking and economic development, and
2. improve the quality of water entering Dark, Sugar and Sinking Creeks.

Project support includes: MDC, AECI, UOE, Missouri Lakes, City of Moberly and Randolph County Farm Bureau.

Saline County SWCD: FINNEY CREEK

Beginning date: July 1, 2002 Completion date: June 30, 2008
Watershed Size: 34,388 acres Project Length: 6 years
Total Budget: $750,000

Land Use in the Watershed:		
	Cropland	70%
	Pasture	20%
	Woodland	4%
	Urban	6%
	Stream Miles	30 miles

Objectives of the AgNPS SALT project include:

1. educate and inform landowners and operators of the watershed about water quality issues and water quality best management practices, and
2. promote the adoption and implementation of best management practices.

Project support includes: MDC, UOE, NRCS and FSA.

Scotland County SWCD: LITTLE FOX CREEK

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 38,516 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:		
	Cropland	27%
	Pasture	6%
	Hayland	6%
	Woodland	7%
	Other	54%
	Stream Miles	11 miles

Objectives of the AgNPS SALT project include:

1. reduce sedimentation by using various eligible AgNPS SALT practices,
2. inform, educate and demonstrate control of sheet and rill erosion on cropland by using Best Management Practices, and
3. reduce sheet and rill erosion to ‘T’ on 75% of cropland.

Project support includes: Various Iowa SWCDs, NRCS, Fox River Ecosystem Development, Pheasants Forever, Northeast RC&D and FSA.

Stone County SWCD: CRANE CREEK

Beginning date: July 1, 2002	Completion date: June 30, 2009
Watershed Size: 53,060 acres	Project Length: 7 years
Total Budget: $750,000	

Land Use in the Watershed:		
	Cropland	1%
	Pasture	59%
	Hayland	20%
	Woodland	17%
	Public	1%
	Other	2%
	Stream Miles	100 miles

Objectives of the AgNPS SALT project include:

1. decrease the amount of sediment/nutrient loading levels entering the stream by developing and implementing total resource management plans on approximately 16,000 acres of pasture and hayland,
2. promote proper waste management as to reduce the amount of pesticides, nutrients and fecal contamination,
3. establish or improve riparian corridors and fence off streams,
4. work with 1,100 acres of road and urban areas such as road side ditches and testing wells,
5. promote or showcase practices being implemented in the watershed through information/education activities such as workshops and tours, and
6. conduct one grazing school for a landowner in the AgNPS SALT area.

Project support includes: Reeds Spring Stream Team, City of Crane, MRCS, MDC, Stone County UOE, SW RC&D, FSA, Farm Credit Service, Earth Team volunteers, Judy Berstresser, County Commission, Stone County Publishing and James River Basin Partnership.

Vernon County SWCD: LOWER MARMATON RIVER

Beginning date: July 1, 2002	Completion date: June 30, 2009
Watershed Size: 35,706 acres	Project Length: 7 years
Total Budget: $ 750,000	

Land Use in the Watershed:		
	Cropland	44%
	Pasture	17%
	Hayland	6%
	Woodland	15%
	Urban	1%
	Other	17%
	Stream Miles	36 miles

Objectives of the AgNPS SALT project include:

1. to prevent further deterioration of the Marmaton River's natural health by reducing contaminants entering the river by means of sedimentation, nutrients, pesticides and animal waste.

Project support includes: NRCS, University of Missouri Cooperative Outreach Extension, MDC and Vernon County Commission.

Webster County SWCD: JAMES RIVER HEADWATERS

Beginning date: July 1, 2002 Completion date: June 30, 2009
Watershed Size: 75,356 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:		
	Cropland	2%
	Pasture	49%
	Hayland	11%
	Woodland	34%
	Urban	2%
	Public	1%
	Other	1%
	Stream Miles	477 miles

Objectives of the AgNPS SALT project include:

1. improve and/or maintain ground and surface water quality and quantity,
2. improve and/or maintain grassland health,
3. improve and/or maintain quality of streams and rivers in the watershed,
4. educate and inform the Amish farmers about applicable conservation practices,
5. improve/maintain woodland health, and
6. educate and inform landowners about noxious weeds in project area to allow desirable plant species to provide adequate ground cover and wildlife habitat.

Project support includes: Webster County Commission, NRCS, UOE, Watershed Committee of the Ozarks, FSA, MDC, James River Basin Partnership and City Utilities.

Caldwell County Soil and Water Conservation District (SWCD):
MUDD CREEK

Beginning date: July 1, 2003 Completion date: June 30, 2010
Watershed Size: 41,499 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:			
	Cropland	15,069 acres	(36%)
	Pasture/Hayland	13,807 acres	(33%)
	CRP	7,437 acres	(18%)
	Urban	772 acres	(2%)
	Woodland	3,961 acres	(10%)
	Public	0 acres	

Other	453 acres (1%)
Stream Miles	28 miles

Objectives of the AgNPS SALT project include:

1. Improve grassland health by planning 900 acres of grazing systems, installing 660 acres of vegetative improvement or enhancement, installling 90 livestock watering supplies.

2. Improve 28 miles of streams in the watershed by educating 160 landowners about the importance of protecting the streams, installing 3 spring development practices, installing 500 acres of filter strips and field borders, and constructing 8 alternative watering systems.

3. Decrease sediment and chemical runoff from entering the streams by installing 2140 acres of terraces, constructing 36 acres of waterways, converting 125 acres of cropland to pasture, planning 800 acres of nutrient and pest management.

4. Improve and maintain woodland health by providing 5000 feet of fencing to exclude livestock from woodland.

5. Improve ground water quality by decommissioning 80 abandoned wells.

Project support includes: Carroll County SWCD, Livingston County SWCD, Ray County SWCD, City of Braymer, National FFA Organization, Braymer Area Young Farmers Organization, Caldwell County Health Center, Caldwell County Commission, NRCS, MDC and FSA.

Cass County SWCD: SOUTH GRAND RIVER

Beginning date: July 1, 2003 — Completion date: June 30, 2010
Watershed Size: 49,656 acres — Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:	Cropland	18,150 acres (36%)
	Pasture/Hayland	24,395 acres (49%)
	CRP	1,050 acres (2%)
	Urban	5 acres (<1%)
	Woodland	4,758 acres (10%)
	Public	631 acres (1%)
	Other	576 acres (1%)
Stream Miles	23 miles	

Objectives of the AgNPS SALT project include**:**

1. Treat 910 acres of pasture and hayland using DSP-2 and MDSP-2 Permanent Vegetative Cover Enhancement and Modified Permanent Vegetative Cover Enhancement, DSP-3 Planned Grazing System and DSP-33 Planned Grazing System with Pond.

2. Reduce nutrient and pesticide runoff on 11,602 acres by encouraging proper farm management techniques using N590 Nutrient Management, N595 Pest Management, DSL-15 No-Till System and N633 Waste Utilization.
3. Protect surface and ground water on 960 acres using N442 Irrigation System, Sprinkler.
4. Prevent sediments, nutrients and pesticides from entering water bodies using 191 acres of buffering practices. These practices include N386 Field Border, N393 Filter Strips, N391 Riparian Forest Buffer and C050 Alternative Watering System.
5. Exclude livestock from 75 acres of woodlands and riparian areas by implementing N472 Use Exclusion.
6. Install 2,000 feet of fence for woodland protection and 5,000 feet of streambank stabilization for streambank protection. These practices include DFR-5 Woodland Protection and C650 Streambank Stabilization.
7. Construct 47,100 feet of erosion control practices to minimize soil erosion off of cropland. Practices to be used include DSL-4 & 44 Terraces and Terraces with Tile and DSL-5 Diversions.
8. Address gully erosion on 5 different sites by installing one DWP-1 Sediment Retention, Erosion or Water Control Structure and five DWC-1 Water Impoundment Reservoirs.
9. Reduce erosion from 516 acres considered critical areas. Practices to be used include DWP-3 Sod Waterways, DSL-11 Permanent Vegetative Cover-Critical Areas and DSL-1 Permanent Vegetative Cover Establishment.
10. Protect ground water quality by developing one spring using N574 Spring Development and decommissioning 14 wells using N351 Well Decommissioning.
11. Construct 3 waste management systems to alleviate animal waste problems using N317 Composting Facility and N312 Waste Management System.
12. Provide assistance to transport 8,500 cubic yards of animal waste from excessive production areas to apply to agricultural land following comprehensive nutrient management criteria. The practice to be used is N634 Manure Transfer.
13. Hold 90 various information/education activities through the life of the project.

Project support includes: NRCS, FSA, MDC, Bates County SWCD, UOE, and Quail Unlimited.

Daviess County SWCD: HICKORY CREEK

Beginning date: July 1, 2003 Completion date: June 30, 2009
Watershed Size: 17,037 acres Project Length: 6 years
Total Budget: $ 455,621

Land Use in the Watershed:			
	Cropland	7,245 acres	(43%)
	Pasture/Hayland	600 acres	(4%)
	CRP	6,547 acres	(38%)
	Urban	10 acres	(<1%)
	Woodland	2,631 acres	(15%)
	Public	0 acres	
	Other	4 acres	(<1%)
	Stream Miles	19 miles	

Objectives of the AgNPS SALT project include:

3. Treat 4,320 acres of cropland for excessive erosion.

4. Treat 3,700 acres of cropland for nutrient and pest management.

5. Treat 480 acres of pastureland.

6. Treat expiring CRP land by installing 32 sediment control structures, and constructing 16 ponds for water supply.

7. Protect the targeted stream by installing stream bank stabilization.

8. Ensure animal feeding operations meet revised water quality standards.

9. Provide outreach and education programs.

10. Develop conservation plans for all landowners.

Project support includes: MO Department of Conservation, Daviess County Commission, University Outreach & Extension, and Natural Resource Conservation Service.

Harrison County SWCD: WEST FORK OF BIG CREEK

Beginning date: July 1, 2003 Completion date: June 30, 2010
Watershed Size: 41,794 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:

Cropland	10,269 acres	(25%)
Pasture/Hayland	18,851 acres	(45%)
CRP	4,684 acres	(11%)
Urban	300 acres	(1%)
Woodland	7,690 acres	(18%)
Public	0 acres	
Other	0 acres	
Stream Miles	29 miles	

Objectives of the AgNPS SALT project include:

6. Achieve a soil erosion level of “T” on 80% of the cropland needing treatment in the project area.
7. Improve management on 4360 acres of pasture.
8. Educate and inform the landowners about the project.
9. Protect and improve 50% of the riparian corridor of the creek.
10. Reduce gully erosion by constructing 63 grade stabilization or water control & sediment control basin.
11. Complete nutrient and pesticide management plans on 2100 acres of cropland in the project area.

12. Protect the ground water in the area by decommissioning 30 abandoned wells.

Project support includes: Natural Resource Conservation Service, Farm Service Agency, MO Department of Conservation, and Ringgold County SWCD (Iowa).

Knox County SWCD: NORTH FORK OF SALT RIVER

Beginning date: July 1, 2003 Completion date: June 30, 2010
Watershed Size: 44,124 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:

Cropland	16,364 acres	(37%)
Pasture/Hayland	19,229 acres	(44%)
CRP	3,848 acres	(9%)
Urban	38 acres	(<1%)
Woodland	4,563 acres	(10%)
Public	0 acres	
Other	82 acres	(<1%)
Stream Miles	120 miles	

Objectives of the AgNPS SALT project include:

1. Reduce gully erosion by implementing 102 sites of various erosion control practices. These practices include DWC-1 Structures, DWP-1 Sediment & Water Control Structures, DSL-5 Diversions, and DWP-3 Sod Waterways.
2. Install 310 acres of buffers to serve as filters along streams and other sensitive areas. The practices used will include N386 Field Border, N393 Filter Strip, N391 Riparian Forest Buffer, N472 Use Exclusion, and C050 Alternative Water System.
3. Reduce sheet and rill erosion on 1600 acres using terrace systems (DSL-4 & DSL-44), Permanent Vegetative Cover Est. DSL-1, and DSL-8 Cropland Protective Cover.
4. Offer crop management practices such as N590 Nutrient Management, N595 Pest Management, and DSL-15 No-till systems on 8,200 acres to introduce environmentally friendly methods of management techniques.
5. Implement 7000 acres of pasture management to reduce sediment and other problems associated with grazing livestock. These practices will include DSP-3/33 Planned Grazing System and Planned Grazing System with Pond, and the MDSP-2 Modified Permanent Vegetative Cover Enhancement.
6. Protect 350 feet of streambank using C650 Streambank Stabilization.
7. Decommission 4 wells to prevent ground water contamination.
8. Hold 67 various information/education activities through the life of the project.

Project support includes: Adair County SWCD, Macon County SWCD, Shelby County SWCD, NRCS, Knox County Public Water District #1, Clarence Cannon Wholesale Water Commission, MDC, FSA, DNR, Missouri Corn Growers Association and the City of Shelbina.

Laclede County SWCD: DRY AUGLAIZE CREEK

Beginning date: July 1, 2003 Completion date: June 30, 2010

Watershed Size: 81,490 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:

Cropland	300 acres	(<1%)
Pasture/Hayland	54,726 acres	(67%)
CRP	64 acres	(<1%)
Urban	2,886 acres	(4%)
Woodland	22,579 acres	(28%)
Public	25 acres	(<1%)
Other	910 acres	(1%)
Stream Miles	42 miles	

Objectives of the AgNPS SALT project include:

3. Install erosion control practices on 1490 acres using DSL-1 Permanent Vegetative Cover Est., DSL-2 Permanent Vegetative Cover Improv. and DSL-8 Cropland Protective Cover.
4. Implement 3,190 acres of pasture management to reduce sediment, fecal coliform and other problems associated with grazing livestock. Practices will include mDSP-2 and DSP-3 Planned Grazing System.
5. Construct 5 Waste Management systems for handling livestock waste. One system will be a N317 Composting Facility and the other 4 will include N312 Waste Management Systems.
6. Protect 174 acres of riparian areas by implementing the N391 Riparian Forest Buffer, N393 Filter Strip, N472 Use Exclusion, and N725 Sinkhole Protection.
7. Encourage proper management techniques by implementing 1,700 acres of Nutrient and Waste Utilization. These practices include N590 Nutrient Management, N633 Waste Utilization and N634 Manure Transfer.
8. Protect 4,619 feet of streambank using C650 Streambank Stabilization.
9. Decommission two wells and develop two springs to protect ground water quality.
10. Offer 146 information/education activities through the life of the project.

Project support includes: NRCS, MDC, UOE and the Boy Scout Troop 58.

Macon County SWCD: LONG BRANCH

Beginning date: July 1, 2003 Completion date: June 30, 2010
Watershed Size: 63,775 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:

Cropland	16,029 acres	(25%)
Pasture/Hayland	15,498 acres	(24%)
CRP	9,525 acres	(15%)
Urban	297 acres	(1%)
Woodland	15,239 acres	(24%)
Public	7,187 acres	(11%)
Other	0 acres	
Stream Miles	245 miles	

Objectives of the AgNPS SALT project include:
1. Implement pasture management on 3,210 acres using DSP-2 Permanent Vegetative Cover Enhancement, DSP-3 Planned Grazing System, and DSP-33 Planned Grazing System with Pond.
2. Prevent excessive gully erosion by treating critical areas on 62 sites. This objective will be accomplished using DSL-11 Permanent Vegetative Cover Critical Area, DWC-1 Water Impoundment Reservoir, DWP-1 Sediment Retention and Water Control Structure, and DWP-3 Sod Waterways.
3. Reduce sheet & rill on 395 acres using DSL-1 Permanent Vegetative Cover Establishment, DSL-4 & 44 Terrace Systems and Terrace Systems with Tile, and DSL-5 Diversions.
4. Protect 23,490 feet of streambanks using the C650 Streambank Stabilization and C050 Alternative Watering Systems.
5. Address streams and other sensitive areas using 230 acres of buffers. These practices include N332 Contour Buffer Strips, N393 Filter Strips, and N391 Riparian Forest Buffers.
6. Protect 940 acres of woodland using DFR-5 Woodland Protection and N472 Use Exclusion.
7. Implement 8,360 acres of Nutrient and Pest Management to encourage landowners to use proper procedures applying nutrients and pesticides.
8. Decommission 7 wells to protect ground water quality.
9. Hold 60 activities to promote public awareness in the watershed.

Project support includes: NRCS, DNR, Macon Municipal Utilities, FSA, UMC-School of Natural Resources, MDC, Macon County Economic Development Corporation, Adair County SWCD, and Long Branch Watershed Local Steering Committee.

Maries County SWCD: UPPER BIG MARIES RIVER

Beginning date: July 1, 2003 Completion date: June 30, 2010
Watershed Size: 61,689 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:			
	Cropland	118 acres	(<1%)
	Pasture/Hayland	33,568 acres	(54%)
	CRP Land	0 acres	
	Urban	141 acres	(<1%)
	Woodland	27,628 acres	(45%)
	Public	234 acres	(<1%)
	Other	0 acres	
	Stream Miles	315 miles	

Objectives of the AgNPS SALT project include:
4. Implement 250 acres of stream exclusion practices using N391 Riparian Forest Buffer, N472 Use Exclusion and C050 Alternative Watering Systems.
5. Reduce soil erosion on 2,080 pasture acres using grassland establishment and improvement practices. These practices include DSL-1 Permanent Vegetative Cover Establishment, DSL-

2 Permanent Vegetative Cover Improvement and DSP-2 Permanent Vegetative Cover Enhancement.

6. Prevent water quality degradation from cropland by establishing 10 acres of buffers such as N386 Field Borders and N393 Filter Strips.
7. Implement 4,200 acres of management intensive grazing practices which will increase water infiltration, decrease runoff and enhance forage production. The practices that will be used include DSP-3, 33 and 333 Planned Grazing System, Planned Grazing System with Pond and Planned Grazing System with Well.
8. Protect ground water by developing 15 springs using N574 Spring Development and decommission 10 wells using N351 Well Decommissioning.
9. Address 25 sites of gully erosion using DWC-1 Water Impoundment Reservoirs.
10. Protect 4,000 feet of streambank using C650 Streambank Stabilization.
11. Install 28,000 feet of fence to exclude livestock from woodlands using DFR-5 Woodland Protection.
12. Address erosion control on 17 critical areas. The practices to be used will by DSL-11 Critical Area Treatment and DWP-3 Sod Waterway.
13. Hold 73 various information/education activities through the life of the project.

Project support includes: NRCS, USFWS, MDC, UOE, FSA, Osage County SWCD, Maries County Commission, City of Vienna, Conservation Federation of Missouri, Maries-Osage Cattlemen's Association, and Meramec Regional Planning Commission.

Osage County SWCD: LOWER BIG MARIES RIVER

Beginning date: July 1, 2003	Completion date: June 30, 2010
Watershed Size: 67,863 acres	Project Length: 7 years
Total Budget: $ 750,000	

Land Use in the Watershed:			
	Cropland	2,664 acres	(4%)
	Pasture/Hayland	26,496 acres	(39%)
	CRP	110 acres	(<1%)
	Urban	135 acres	(<1%)
	Woodland	38,354 acres	(57%)
	Public	104 acres	(<1%)
	Other	0 acres	
	Stream Miles	279 miles	

Objectives of the AgNPS SALT project include:

1. Establish and improve 1,115 acres of grassland using DSL-1 Permanent Vegetative Cover Establishment, DSL-2 Permanent Vegetative Cover Improvement, DSP-2 Permanent Vegetative Cover Enhancement and DSL-11 Permanent Vegetative Cover – Critical Areas.
2. Reduce soil erosion from 300 acres of cropland using the DSL-15 No-Till Systems.
3. Establish grazing systems on 3,000 acres to enhance forage production which will increase water infiltration and decrease soil erosion and nutrient runoff. The practices to be used include DSP-3, 33 and 333 Planned Grazing System, Planned Grazing System with Pond and Planned Grazing System with Well.
4. Protect 6,000 feet of streambank using C650 Streambank Stabilization.

5. Prevent agricultural non point source pollution from entering streams by establishing 550 acres of buffering practices. These practices include C050 Alternative Watering Systems, N391 Riparian Forest Buffer and N386 Field Border.
6. Construct 6 waste management systems to alleviate animal waste problems. This goal is comprised of five N317 Composting Facilities and one N312 Waste Management Systems.
7. Protect ground water by developing 15 springs using N574 Spring Development and decommissioning 7 wells using N351 Well Decommissioning.
8. Prevent gully erosion on 12 sites using DWC-1 Water Impoundment Reservoir.
9. Reduce nutrient runoff by encouraging landowners to properly apply animal waste following comprehensive nutrient management plan standards using the N633 Waste Utilization on 3,500 acres.
10. Provide assistance to transport 50,000 cubic yards of animal waste from excessive production areas to be applied to agricultural land following nutrient management criteria. The practice to be used is N634 Manure Transfer.
11. Construct 12,000 feet of fence to protect woodlands from livestock use. The DFR-5 Woodland Protection practice will be used for livestock exclusion.
12. Hold 55 various information/education activities through the life of the project.

Project support includes: National Wild Turkey Federation, Maries County SWCD, NRCS, Conservation Federation of Missouri, MDC, USFWS, UOE, Marie-Osage Cattlemen's Association, Osage County Commission, FSA, Meramec Regional Planning Commission, DNR, and Osage Independent Pork Producers.

Ozark County SWCD: SOUTH BULL SHOALS

Beginning date: July 1, 2003 Completion date: June 30, 2010
Watershed Size: 55,386 acres Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:			
	Cropland	500 acres	(1%)
	Pasture/Hayland	18,184 acres	(33%)
	CRP	0 acres	
	Urban	640 acres	(1%)
	Woodland	22,713 acres	(41%)
	Public	7,556 acres	(14%)
	Other	5,793 acres	(10%)
	Stream Miles	28 miles	

Objectives of the AgNPS SALT project include:

6. Reduce erosion on 1,150 acres using erosion control practices. These practices include DSL-1 Permanent Vegetative Cover Establishment and DSL-2 Permanent Vegetative Cover Improvement.
7. Enhance pasture conditions through proper grazing management on 5,540 acres by establishing DSP-3 Planned Grazing Systems, DSP-33 Planned Grazing System with Pond and DSP-2 Permanent Vegetative Cover Enhancement.
8. Protect 1,790 acres of woodlands using DFR-4 Forest Plantation, N472 Use Exclusion and Timber Stand Improvement (Funded specifically through MDC and NRCS).

9. Construct 10,000 feet of fence to exclude livestock from woodlands and other sensitive areas using the DFR-5 Woodland Protection practice.
10. Prevent sediment and nutrient runoff by implementing 130 acres of buffering practices. These practices include N391 Riparian Forest Buffer, C050 Alternative Watering Systems and CCRP Continuous Conservation Reserve Program practices (Funded through FSA).
11. Protect 1,500 feet of streambank stabilization using C650 Streambank Stabilization practice.
12. Protect ground water quality by developing five springs using N574 Spring Development and decommissioning ten wells using N351 Well Decommissioning.
13. Prevent animal waste from entering streams by constructing two N312 Waste Management Systems.
14. Promote proper application of nutrients on 4,240 acres of pasture and hayland using the N590 Nutrient Management and N633 Waste Utilization.
15. Hold 85 various information/education activities through the life of the project.

Project support includes: NRCS, USFWS, MDC, Upper White River Basin Foundation, Ozark County Times, FSA, UOE, Quail Unlimited, Department of the Army, Lutie R-VI Accelerated School, AAA Accounting & Financial Services, Gaston's White River Resort, Gainesville Lions Club, Ozark Cattlemen's Association, Thornfield School, Gainesville FFA, and Pontiac Cove.

Shelby County SWCD: NORTH FORK SALT RIVER

Beginning date: July 1, 2003 | Completion date: June 30, 2010
Watershed Size: 67,666 acres | Project Length: 7 years
Total Budget: $750,000

Land Use in the Watershed:

Cropland	23,698 acres	(35%)
Pasture/Hayland	28,835 acres	(43%)
CRP	2,675 acres	(4%)
Urban	216 acres	(<1%)
Woodland	11,547 acres	(17%)
Public	276 acres	(<1%)
Other	419 acres	(1%)
Stream Miles	132 miles	

Objectives of the AgNPS SALT project include:

7. Reduce erosion on 10,000 acres of cropland by constructing 262,585 feet of terraces, and installing 37 grade stabilization or water control & sediment control basin, installing 61 acres of grass waterways.

8. Reduce the amount of atrazine, nutrients and pesticides on 1,000 acres through implementation of BMPs.

9. Develop and implement one Comprehensive nutrient management plan on an existing animal waste system.

10. Implement or install 150 acres of riparian protection by installing 100 acres of Filter Strips, implementing 25 acres of riparian forest buffer, and installing 25 acres of field borders

Project support includes: Macon Co SWCD, NRCS, FSA, NERO, Department of Defense, Clarence Cannon Wholesale Water Commission and the City of Shelbina.

Warren County SWCD: CHARETTE CREEK

Beginning date: July 1, 2003 — Completion date: June 30, 2010
Watershed Size: 90,562 acres — Project Length: 7 years
Total Budget: $ 750,000

Land Use in the Watershed:

Cropland	19,224 acres	(21%)
Pasture/Hayland	14,081 acres	(16%)
CRP	1,326 acres	(1%)
Urban	22,122 acres	(24%)
Woodland	31,636 acres	(35%)
Public	1,408 acres	(2%)
Other	756 acres	(1%)
Stream Miles	298 miles	

Objectives of the AgNPS SALT project include:

1. Maintain and improve pastureland/grassland in the watershed by implementing rotational grazing on 1010 acres of grassland, and establishing or improving grassland on 1200 acres.

2. Maintain and improve water quality by providing buffers on 200 acres, assisting in cropland protection on 800 acres, installing 11,200 feet of terraces or diversions, offering nutrient & pest management plans on 1000 acres, providing waste management on 6 acres, excluding or installing riparian buffers on 2235 acres,

3. Protect surface and ground water by developing 5 springs into livestock watering, decommissioning 20 abandoned wells, constructing 39 acres of sod waterways or critical area treatment, and installing 5000 feet of stream bank protection.

Project support includes: Natural Resource Conservation Service, MO Department of Conservation, University Outreach & Extension, Loutre River Quail Unlimited, MFA, Bellflower Service and Supply Coop, and Innsbrook Corporation.

WATERSHED IMPLEMENTATION
DNR SOIL AND WATER CONSERVATION PROGRAM

Table 21. SPECIAL AREA LAND TREATMENT (SALT) AND EARTH WATERSHED PROJECTS

NPS CATEGORY/ SUBCATEGORY	**WATERSHED NAME** START DATE	**ACTIVITY**	**COUNTY**	**WATERSHED ACREAGE**	**WATERBODY TYPE**	**USE IMPAIRMENTS**	**POLLUTANTS**
SALT							
10	Big Deer Creek 1990	Soil erosion prevention land treatment-- terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Bates	11801	Stream	Threatened aquatic life	Sediment Nutrients pesticides
10	Malone Creek 1990	Soil erosion prevention land treatment-- terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Bollinger	5912	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Crabtree Branch 1990	Soil erosion prevention land treatment-- terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Cedar	4400	Stream	Threatened aquatic life	Sediment nutrients pesticides

10	Palmer Creek 1990	Soil erosion prevention land treatment--terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Chariton	10227	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Lake Creek 1990	Soil erosion prevention land treatment--terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Chariton	11803	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Jordan Creek 1990	Soil erosion prevention land treatment--terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Dade	5500	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Tombstone Creek 1990	Soil erosion prevention land treatment--terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Daviess/ Harrison	12800	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Linn Creek 1990	Soil erosion prevention land treatment--terraces, grassed waterways, water	Gentry	4300	Stream	Threatened aquatic life	Sediment nutrients pesticides

		impoundments, conversion of cropland to grassland, conservation tillage.					
10	Strate Branch 1990	Soil erosion prevention land treatment-- terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Marion	5690	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Birdtown Hollow 1990	Soil erosion prevention land treatment-- terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Ozark	6419	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Marlowe Creek 1990	Soil erosion prevention land treatment-- terraces, grassed waterways, water impoundments, conversion of cropland to grassland, conservation tillage.	Worth	7877	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Middle Creek 1990	Soil erosion prevention land treatment-- terraces and structures to treat active gullies.	Grundy	4000	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Trail Creek 1990	Soil erosion prevention land treatment-- terraces, conservation	Harrison	17300	Stream	Threatened aquatic life	Sediment nutrients pesticides

		tillage and structures to treat active gullies.					
10/11	Porter Creek 1990	Soil erosion prevention land treatment--conservation tillage and terracing to protect Squaw Creek Wildlife Refuge.	Holt	1961	Wetland	Threatened recreation wildlife water, aquatic life	Sediment nutrients pesticides
10/11	Price's Branch 1990	Soil erosion prevention land treatment--conservation tillage and terracing to protect cropland.	Montgomery	5149	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Long Grove Branch 1990	Soil erosion prevention land treatment--conservation tillage and terracing to protect cropland.	Pettis	7265	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11,14	North Fabius/ Downing Lake 1990	Soil erosion prevention land treatment--pasture management, conservation tillage and structures to prevent erosion for the protection of the Downing water supply lake.	Schuyler	1200	Lake	Threatened drinking water supply	Sediment nutrients pesticides
10/11	Dry Creek 1990	Soil erosion prevention--terracing and conservation tillage.	Warren	3488	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/14	Little Hazel Creek 1991	Soil erosion prevention--pasture improvement and tree planting.	Adair	5240	Stream	Threatened aquatic life	Sediment nutrients pesticides

10/11	Mace Creek 1991	Soil erosion prevention on cropland-- terraces to protect the Amazonia levee district and Savannah City Reservoir.	Andrew	9358	Stream Lake	Threatened drinking water supply	Sediment nutrients pesticides
10/11	Upper Lincoln Creek 1991	Soil erosion prevention land treatment-- terracing.	Andrew	7835	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Dumas Creek 1991	Soil erosion prevention land treatment-- terracing.	Clark	7652	Stream	Threatened aquatic life	Sediment
10/14	West Yellow Creek trib. 1991	Soil erosion prevention land treatment--through pasture improvement and gully stabilization structures.	Linn	2.323	Stream	Threatened aquatic life	Sediment
10/11	Franklin School Branch 1991	Soil erosion prevention and water control structures for storm water storage.	Marion	2450	Stream	Threatened aquatic life	Sediment
10/11	Jenkins Creek 1991	Soil erosion prevention through terracing FSA farmland.	Nodaway	5400	Stream	Threatened aquatic life	Sediment
10/14	Turkey Creek 1991	Soil erosion prevention through use of warm season grasses, no-till drill and other grassland management practices.	Ozark	6518	Lake	Threatened fishing, boating, aquatic life	Sediment
10/11	Salt Branch 1991	Soil erosion prevention on FSA cropland by terracing.	Saline	2855	Stream	Threatened aquatic life	Sediment nutrients pesticides

10/14	Greentop/ Queen City Lakes 1991	Soil erosion prevention by conservation tillage, pasture management, and water control structures.	Schuyler	2371	Lakes	Threatened drinking water supply	Sediment nutrients pesticides
10/11,12	Upper Northcut Ditch 1991	Prevent soil erosion through installing structures near the base of upland acres.	Scott	4453	Drainage ditches	Threatened aquatic life	Sediment
10/11	Clarence Watershed 1991	Treat cropland erosion with terracing.	Shelby	4020	2 lakes	Threatened drinking water supply (Clarence now buys water from Macon PWSD #1)	Sediment nutrients pesticides
10/14	Elmwood Lake 1991	Reduce soil erosion in watershed by improving pastures and building grade stabilization structures.	Sullivan	4237	Lake	Threatened drinking water supply	Sediment nutrients pesticides
10/11	Crowley's Ridge 1991	Prevent erosion by reducing rate of runoff from upland areas by installation of dry sediment structures.	Stoddard	775	Drainage ditches	Threatened aquatic life	Sediment nutrients pesticides
10/11	Yeatter Branch 1991	Protect highly erodible FSA cropland using terraces.	Warren	3799	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11,14,18	Whetstone Creek 1991	Erosion prevention through pasture and hayland management. Project also focuses on	Wright	19081	Stream	Threatened aquatic life	Sediment nutrients

		animal waste management.					
10/11	Lower Pedlar Area 1991	Protect highly erodible FSA cropland using terraces.	Andrew	3989	Stream	Threatened aquatic life	Sediment nutrients pesticides
10	Hickory Ridge 1991	Erosion prevention by reducing rate of runoff from upland crop areas.	Stoddard/ Cape Girardeau	8490	Drainage ditches	Threatened aquatic life	Sediment nutrients pesticides
10/11	Contrary Creek 1992	Soil erosion control of deep loess cropland by use of terracing and structural practices.	Buchanan	4700	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11,14	Lick Fork 1992	Soil erosion control of cropland and grassland through pasture management practices and structural practices.	Caldwell/ Daviess	5700	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Little Hurricane Creek 1992	Soil erosion prevention through the use of contouring, conservation tillage, and terracing.	Carroll	6300	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Sam's Branch 1992	Soil erosion control through reduced tillage, filter strips, and stripcropping practices.	Dade	3627	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/14	Tunas Branch 1992	Soil erosion control on grassland through grass renovation, warm season grass plantings and improved grazing systems.	Dallas	3540	Stream	Threatened aquatic life	Sediment nutrients
10/11	Cypress Creek	Control of sheet and rill	Harrison	11600	Stream	Threatened	Sediment

	1992	erosion on cropland through structural practices such as terracing. A side goal is reduction of sedimentation downstream.				aquatic life	nutrients pesticides
10/14	Turkey Creek 1992	Improvement of pasture and hayland to reduce grassland erosion.	Hickory	6669	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Little Turkey Creek 1992	Soil erosion prevention through the adoption of terracing and other structural practices. This watershed is a tributary of Silver Lake, a wetland area located in the Swan Lake Wildlife Area.	Linn	6410	Wetland	Threatened aquatic life, wildlife water	Sediment nutrients pesticides
10/11	Little Coon Creek 1992	Control of erosion on cropland through a combination of structural and management practices.	Montgomer y	4313	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11,14,18	Little Maries Creek 1992	Primary objective will be reduction of erosion on cropland and grassland using a variety of conservation practices. A secondary goal will be to improve water quality through animal waste system planning.	Osage	18355	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Beaverdam Creek	Control of erosion on cropland using non-	Pettis	5869	Stream	Threatened aquatic life	Sediment nutrients

	1992	structural practices will be encouraged.					
10/11	Jowler Creek 1992	Erosion control of cropland using terracing and structural practices.	Platte	4142	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	West Yellow Creek #2 1992	Erosion control on gullies and cropland. Practices to be used will be non-structural for cropland and structural for treating gully erosion.	Sullivan	3170	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	McGuire Branch 1992	Control of erosion on cropland using structures, waterways, and terraces.	Clinton	12160	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Horse Fork 1992	Control of erosion on cropland using structures, waterways, and terraces.	Clinton	9600	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Honey Creek 1992	Treatment of erosion on cropland with terraces, waterways, and diversions.	Cole	6337	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Unionville City Reservoir 1992	Reduction of gully erosion through the use of sediment retention structures. Another objective is to reduce sediment movement into the Unionville City Reservoir.	Putnam	1839	Lake	Threatened drinking water supply, boating aquatic life	Sediment nutrients pesticides
10/11	Four-Mile Branch 1993	Erosion prevention by conservation tillage, contouring and terraces.	Callaway/ Audrain	6337	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Snow Branch	Combination SALT and	Carroll	2000	Stream	Threatened	Sediment

	1993	P.L. 566 watershed project designed to prevent cropland erosion with terraces and waterways.				aquatic life	nutrients pesticides
10/11	Wolf Creek 1993	Erosion prevention by terracing and erosion control structures.	Carroll	4274	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Little Platte 1993	Erosion prevention by modified farming practices.	Clinton/ Dekalb	14992	Lake	Threatened aquatic life	Sediment nutrients pesticides
10/11	Coalbank Creek 1993	Erosion prevention of highly erodible land by treating with an intensified grazing system and woodland improvement.	Cooper	8162	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Upper Dry Creek 1993	Control of erosion by renovation and establishing pastures by planting warm season grasses, and introduction of legumes.	Dallas	3700	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Bear Branch 1993	Erosion prevention by protecting highly erodible cropland.	Daviess	3865	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Walnut Fork 1993	Soil erosion control by providing technical assistance for treating cropland and improving livestock water supply.	Gentry	11000	Stream	Threatened aquatic life, livestock water	Sediment nutrients pesticides

10/11	Long Branch 1993	Controlling erosion on cropland through a combination of structures and management practices.	Gentry	9000	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Hogles Creek 1993	Primary goal is to reduce erosion on the predominate pasture and hayland by implementing a good management practice with the landowners.	Hickory	8878	Stream	Threatened aquatic life	Sediment
10/11	Central Kimsey Creek 1993	Soil erosion control on the highly erodible acres by using technical assistance and good management practices.	Holt	4448	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Nichols Creek 1993	Control of erosion on cropland by using a variety of conservation practices. A main concern is to reduce the sediment delivery downstream.	Holt	4338	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Hawkins Branch 1993	Combining with the P.L. 566 watershed in this area to reduce the erosion in this mostly cropland watershed.	Knox	5768	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Little Troublesome Creek 1993	This area's goal is completing the required land treatment above the proposed structure sites in their P.L. 566 watershed.	Knox	2463	Stream	Threatened aquatic life	Sediment nutrients pesticides

10/11	Bear Branch 1993	Control runoff in predominately grassland, by treating the project area with various conservation practices.	Linn	5179	Stream	Threatened aquatic life	Sediment
10/11	Wildcat Creek 1993	Control erosion by targeting pasture improvement practices. Promoting good management by sponsoring a conservation demonstration on the FFA farm.	Mercer	3250	Stream	Threatened aquatic life	Sediment
10/11	Bear Creek 1993	Erosion control of cropland by using a variety of management practices and treatments.	Montgomer y	5700	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Straight Branch 1993	Erosion control on cropland by using residue management incentives.	Ralls	4784	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Burnt Fork 1993	Soil erosion awareness through a demonstration area to promote conservation for cropland and pasture.	Ray	4431	Stream	Threatened aquatic life	Sediment
10/11	West Yellow Creek 1993	Control gully erosion through water impoundment structures and sediment basins.	Sullivan	10638	Stream	Threatened aquatic life	Sediment
10/11	Big Rock Creek 1993	Erosion control practices focusing on cropland.	Worth/ Harrison	8770	Stream	Threatened aquatic life	Sediment nutrients pesticides

10/11	Clark Creek 1993	Erosion control will be addressed by forage Improvement and livestock restriction. Stabilization of stream bank erosion will also be addressed.	Wright	16252	Stream	Threatened aquatic life	Sediment nutrients
10/11	Big Bear 1994	Erosion prevention in the watershed.	Adair	30323	Stream	Threatened aquatic life	Sediment
10/11	Agee Creek 1994	Protect highly erodible cropland by using good management practices.	Andrew	6071	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Long Branch Creek 1994	Control highly erodible cropland acres by using erosion control practices.	Andrew	4864	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Turkey & Bass Creek 1994	Soil erosion control on predominately cropland through a variety of good management practices.	Boone	13415	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Callaway Branch 1994	Soil erosion control practices by use of terraces, waterways, and erosion control structures.	Carroll	2657	Stream	Threatened aquatic life	Sediment
10/11	Upper Alder Creek 1994	Erosion control practices include establishing warm season grasses and rotational grazing. A secondary goal is to enhance the prairie chicken	Cedar	5650	Stream	Threatened aquatic life	Sediment

		habitat.					
10/11	Logans Creek 1994	Control erosion by pasture, cropland and woodland improvement.	Cole	5400	Stream	Threatened aquatic life	Sediment nutrients
10/11	Gray's Creek 1994	Primary objective will be reduction of erosion on cropland, pasture and woodland using technical assistance.	Cole	14900	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Ingalls Creek 1994	Erosion control by improving forages, livestock watering facilities, and fencing systems and promoting warm season grasses.	Dallas	3400	Stream	Threatened aquatic life	Sediment nutrients
10/11	Second Creek 1994	Control erosion by improving forages, livestock exclusion through fencing, introduction of warm season grasses and legumes, and reduce soil loss on cropland.	Gasconade	32430	Stream	Threatened aquatic life	Sediment nutrients
10/11	Sugar Creek 1994	Control sheet and gully erosion through demonstrations, increased information and additional technical assistance.	Harrison	19020	Stream	Threatened aquatic life	Sediment
10/11	Belleview Valley 1994	Control erosion on predominately pasture and woodland by	Iron	12463	Stream	Threatened aquatic life	Sediment

		implementing good management practices.					
10/11	Little Lead Creek 1994	Control erosion on cropland and pastures by promoting no-till seeding for crop establishment and enhancement.	Lincoln	6628	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Hickory Branch 1994	Soil erosion control practices by use of terraces, waterways, and erosion control structures.	Linn	6092	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Blackwell Creek 1994	Soil erosion control practices by use of terraces, waterways, and erosion control structures.	Livingston	6033	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Greasy Creek 1994	Soil erosion control practices by use of terraces, waterways, and erosion control structures.	Madison	11319	Stream	Threatened aquatic life	Sediment
10/11	Hawkins Branch 1994	Control erosion, improve water quality, minimize flooding and decrease siltation through use of various soil conservation practices.	Marion	6175	Stream	Threatened aquatic life	Sediment
10/11	Big Branch	Control erosion, improve water quality, minimize flooding and decrease siltation by constructing water, sediment and	Marion	6790	Stream	Threatened aquatic life	Sediment

		erosion control structures.					
10/11	Irwin Creek 1994	Soil erosion control through construction of terraces.	Mercer	6410	Stream	Threatened aquatic life	Sediment
10/11	Contrary Creek 1994	Install management practices to decrease sediment delivery into the creek.	Osage	10036	Stream	Threatened aquatic life	Sediment
10/11	Brush Creek 1994	Control erosion through pasture planting and improvement, gully and sediment control structures, terraces, conservation tillage, and wildlife habitat improvement.	Schuyler	2880	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Little Caney Creek 1994	Install 30 grade stabilization structures to control gully erosion and retain sediment.	Scott	6337	Stream	Threatened aquatic life	Sediment
10/11	North Fork of Gallinipper 1994	Control erosion on pasture, cropland and timber through conservation practices.	St. Clair	5182	Stream	Threatened aquatic life	Sediment
10/11	Peachtree Fork 1994	Prevent soil erosion in woodland through livestock exclusion. Control gully erosion using water impoundment in cropland and woodland.	Wayne	6335	Stream	Threatened aquatic life	Sediment nutrients
10/11	Lower Marlowe Creek	Control gully erosion through structure	Worth	8024	Stream	Threatened aquatic life	Sediment

	1994	Installation.					
10/11	Wolf Creek 1994	Pastureland and hayland improvement.	Wright	23830	Stream	Threatened aquatic life	Sediment nutrients
10/11	Pyletown 1994	Install grade stabilization structures, rotational grazing, reduced tillage, crop rotation, and residue maintenance.	Stoddard	3990	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Dry Creek 1994	Install sediment and erosion control structures and complete resource management systems for cropland, pasture and woodland.	Bollinger	8853	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Upper Long Branch 1994	Use no-till farming particularly on highly erodible land.	Boone	6075	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	North Contrary Creek 1994	Implement good conservation management Practices.	Buchanan	2878	Stream	Threatened aquatic life	Sediment
10/11	Garrettsburg 1995	Erosion and flood control by increasing pasture and grassland quality through good management practices.	Buchanan	4505	Stream	Threatened aquatic life	Sediment nutrients
10/11	Sugar Creek 1995	Control erosion on highly erodible cropland by contour farming and good management practices.	Buchanan	3668	Stream	Threatened aquatic life	Sediment nutrients
10/11	Little Otter Creek	Control erosion through technical assistance with	Caldwell	5585	Stream	Threatened aquatic life	Sediment

	1995	planning and management of planned grazing systems.					
10/11	Jones Branch 1995	Install erosion control structures and improve forage quality.	Chariton	7909	Stream	Threatened aquatic life	Sediment
10/11	Goff Creek 1995	Establish good grazing systems and promote better grazing management.	Christian	3231	Stream	Threatened aquatic life	Sediment nutrients
10/11	Dry Fork 1995	Install planned grazing systems and management plans including livestock exclusion.	Dent	14000	Stream	Threatened aquatic life	Sediment nutrients
10/11	Clifty Creek 1995	Install controlled grazing systems, forage management, no-till seeding, livestock exclusion from woodlands.	Douglas	12749	Stream	Threatened aquatic life	Sediment nutrients
10/11	No Creek 1995	Control erosion with structures, terraces, waterways, critical area seedings and good management practices.	Grundy	20996	Stream	Threatened aquatic life	Sediment
10/11	Crooked Creek 1995	Control erosion with structures, terraces, contouring, and improving pasture and hay land with no-till.	Grundy	6289	Stream	Threatened aquatic life	Sediment
10/11	Upper White Oak Creek 1995	Provide technical assistance and promote use of no-till drill.	Harrison	12165	Stream	Threatened aquatic life	Sediment
10/11	Crane Creek	Implement rotational	Hickory	11067	Lake	Threatened	Sediment

	1995	grazing, improved forage systems and streambank erosion control.				aquatic life	nutrients
10/11	Davis Creek 1995	Control sheet and gully erosion by constructing water impoundments and reservoirs throughout the watershed.	Holt	8074	Stream	Threatened aquatic life	Sediment
10/11	Hickory Creek 1995	Prevent soil erosion and chemical runoff to the Nodaway River by using a variety of conservation practices.	Holt	5921	Stream	Threatened aquatic life	Sediment pesticides nutrients
10/11	Elkhorn Branch 1995	Pasture and hayland improvement.	Howell	3974	Stream	Threatened aquatic life	Sediment nutrients
10/11	Elk Creek 1995	Install terraces, waterways, structures, seeding and interseeding.	Linn	12633	Stream	Threatened aquatic life	Sediment
10/11	Coon Creek 1995	Use contouring and no-till.	Livingston	5171	Stream	Threatened aquatic life	Sediment
10/11	Village Creek 1995	Improved pasture and hayland and livestock exclusion to reduce erosion.	Madison	7680	Stream	Threatened aquatic life	Sediment nutrients
10/11	Bear Creek 1995	Use of crop residue management, no-till planting systems, critical area seeding, and mechanical practices to reduce erosion and runoff from cropland.	Marion	9160	Stream	Threatened aquatic life	Sediment nutrients pesticides

10/11	Lick Creek 1995	Improved pasture management, no-till planting systems, critical area seeding, and mechanical practices to reduce erosion and runoff from cropland.	Marion	6500	Stream	Threatened aquatic life	Sediment nutrients
10/11	Brush Creek 1995	Promote better cropland and pasture management practices.	Mercer	6700	Stream	Threatened aquatic life	Sediment nutrients
10/11	Clear Fork 1995	Erosion control using minimum- and no-till. Promote intensive grazing and other conservation practices.	Montgomer y	16640	Stream	Threatened aquatic life	Sediment nutrients
10/11	E. Branch Jenkins 1995	Erosion control using waterways, structures, sediment basins, terraces and seeding.	Nodaway	3784	Stream	Threatened aquatic life	Sediment
10/11	E. Branch Elkhorn 1995	Erosion control using waterways, structures, sediment basins, terraces, seeding and alternative livestock water sources.	Nodaway	5340	Stream	Threatened aquatic life	Sediment nutrients
10/11	Swan Creek/ Graveyard Branch 1995	Reduced runoff and sedimentation by increasing grassland management, improved animal waste management and timber management.	Osage	10287	Stream	Threatened aquatic life	Sediment nutrients
10/11	Panther Creek 1995	Reduce soil loss using terraces, waterways,	Polk	7450	Stream	Threatened aquatic life	Sediment nutrients

		contouring, strip cropping, minimum tillage, no-till and livestock exclusion.					
10/11	Little Locust Creek 1995	Erosion control and water quality protection through promotion of rotational or management intensive grazing and livestock exclusion from woodland.	Putnam	8970	Stream	Threatened aquatic life	Sediment nutrients
10/11	Turkey Creek 1995	Erosion control and water quality protection through promotion of rotational or management intensive grazing and livestock exclusion from woodland.	Putnam	7880	Stream	Threatened aquatic life	Sediment nutrients
10/11	Hays Creek 1995	Controlled grazing, residue management and other erosion control practices.	Ralls	6625	Stream	Threatened aquatic life	Sediment
10/11	Turkey Creek 1995	Good residue management for erosion control on cropland.	Ralls	3165	Stream	Threatened aquatic life	Sediment
10/11	Fish Creek 1995	Erosion control through narrow-base terraces, grass back terraces, conservation tillage, and livestock exclusion.	Saline	13637	Stream	Threatened aquatic life	Sediment nutrients
10/11	North Fork Little Fabus 1995	Erosion control with terraces, conservation tillage, and gully/sediment control structures.	Schuyler	2942	Stream	Threatened aquatic life	Sediment
10/11	Dry Crane Creek	Control erosion on steep slopes with seeding,	Stone	8019	Stream	Threatened aquatic life	Sediment

	1995	planting trees and creek bank stabilization.					
10/11	Long Branch 1995	Control soil erosion and protect water quality through no-till, reduced tillage, contour farming, terracing, and grade stabilization structures.	Sullivan	4556	Stream	Threatened aquatic life	Sediment
10/11	West Piney 1995	Control soil erosion on woodland and pastures using no-till, livestock exclusion, streambank stabilization and good forage and woodland management.	Texas	42880	Stream	Threatened aquatic life	Sediment nutrients
10/11	Elk Creek 1995	Erosion control with streambank stabilization, no-till, livestock exclusion, forage management and controlled grazing.	Wright	30270	Stream	Threatened aquatic nutrients	Sediment nutrients
10/11,14	Painter Creek 1995	Erosion control and water quality protection through promotion of rotational grazing and spring development.	Macon	3710	Stream	Threatened aquatic life	Pesticides, nutrients
10/14	Caney Mountain	Protection of water quality through improved grassland and woodland management.	Ozark	4090	Stream	Threatened aquatic life	Nutrients

EARTH							
10/11	Honey, Dog, & Marrowbone Creeks 1992	Soil erosion prevention land treatment and gully stabilization structures.	Daviess	61800	Stream	Threatened aquatic life	Sediment
10/11	Troublesome Creek 1992	Combination EARTH project and NRCS P.L. 566 watershed project designed to prevent cropland erosion through land treatment and installation of structures.	Knox	22958	Stream	Threatened aquatic life	Sediment
10/11	Parsons Creek 1992	Erosion prevention by land treatment and gully stabilization structures. Creek drains into Fountain Grove Wildlife Area.	Livingston/ Linn	63680	Wetland	Threatened Recreation Wildlife water, aquatic life	Sediment nutrients pesticides
10/11	Wolf Creek 1992	Erosion prevention of cropland by land treatment.	Montgomer y	10400	Stream	Threatened aquatic life	Sediment
10/11	Cow Creek 1992	Erosion prevention through terracing and gully stabilization structures.	Saline	20013	Stream	Threatened aquatic life	Sediment
10/11	Peruque Creek 1992	Erosion prevention by terracing of cropland and installation of gully stabilization structures.	Warren	11395	Lake	Threatened aquatic life	Sediment nutrients pesticides
10/11	Monticello	Erosion prevention by	Lewis	12800	Stream	Threatened	Sediment

	Basin 1992	terracing of cropland and installation of gully stabilization structures.				aquatic life	
10/11	Little Cedar Creek 1993	Erosion control on predominate cropland and pasture by improving land management and conservation practices.	Boone	11700	Stream	Threatened aquatic life	Sediment
10/11	West Muddy Creek 1993	Erosion control through farm conservation planning, gully and sediment control structures, and conservation tillage.	Mercer	19360	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Otter Creek 1993	Decrease soil loss and improve water quality by constructing water impoundments and reservoirs within gullies.	Monroe/ Shelby	67200	Stream	Threatened aquatic life	Sediment
10/11	Bear Creek 1993	Pasture improvement, livestock exclusion and timber stand improvement practices.	Scotland	23120	Stream	Threatened aquatic life	Sediment nutrients
10/11	Bee Branch 1994	Erosion prevention through use of no-till, diversions, grade stabilization structures and pasture improvement.	Chariton	20339	Stream	Threatened aquatic life	Sediment nutrients
10/11	Big Muddy Creek 1994	Erosion control by terraces, no-till, contour farming, conservation tillage and seeding.	Daviess	75616	Stream	Threatened aquatic life	Sediment nutrients pesticides

10/11	Little Third Fork 1994	Reduced erosion, flooding and sedimentation through installation of structures and soil conservation practices.	Dekalb	40414	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Dry Fork 1994	Installation of soil stabilization structures and grassed waterways, treatment of critical areas and pasture establishment.	Montgomer y	16200	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Cedar Creek 1994	Pasture and hayland improvement and management, livestock exclusion from woodland, installation of erosion control structures.	Osage	33580	Stream	Threatened aquatic life	Sediment nutrients
10/11	Shaver Creek 1994	Erosion control through terraces, waterways, no-till systems, rotational grazing, livestock exclusion, and installation of erosion control structures.	Pettis	19524	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Bear Creek 1994	Improved residue management and grassland management for erosion control.	Platte	21069	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11	Barber Creek 1994	Erosion control through critical area treatment, water and sediment control basins and rotational grazing.	Putnam	14721	Stream	Threatened aquatic life	Sediment nutrients
10/11	Camp Branch	Erosion control through	Warren	10664	Stream	Threatened	Sediment

	1994	waterways, terraces, no-till and critical area seeding.				aquatic life	nutrients pesticides
10/11	Little Medicine Creek 1994	Treat cropland erosion by use of no-till, terraces, and contouring, with drainageways and steep slopes seeded to grasses.	Mercer	49670	Stream	Threatened aquatic life	Sediment nutrients pesticides
10/11,14	Crooked Creek 1995	Control erosion through grassland management, livestock exclusion from woodlands, and erosion control structures.	Bollinger	30362	Stream	Threatened aquatic life	Nutrients
10/11,14	Son's Creek 1995	Control erosion and protect water quality through construction of terraces and waterways, conservation tillage, filter strips, crop rotation, and pasture management. Creek drains into Lake Stockton, which is primary water supply for Springfield.	Dade	60600	Lake	Threatened drinking water supply, aquatic life	Nutrients
10/14,22	Crane Pond Creek 1995	Control erosion and protect water quality through forage management, streambank protection, and timber stand improvement.	Iron	23680	Lake	Threatened aquatic life	Sediment, nutrients
10/11,14,22	Turkey Creek 1995	Control erosion and protect water quality through cropland management,	Linn	18622	Lake	Threatened recreation wildlife water,	Nutrients, pesticides, sediments

		reduced tillage practices, structural and other methods of gully treatment, livestock exclusion from riparian areas and woodland management.				aquatic life, siltation	
10/11,14	Medicine Creek 1995	Erosion control through no-till and contour cultivation, terraces, and drainageways, and structural controls on gully areas.	Mercer	49670	Stream	Threatened aquatic life	Sediment, nutrients, pesticides
10/11,14,22	Brush Creek 1995	Reduce erosion on cropland, improve pasture conditions, and improve water quality through agronomic structural and non-structural practices, pasture improvement, grazing management, timber stand improvement, and stream corridor protection.	Polk	52520	Stream	Threatened aquatic life, particularly the Niangua Darter	Sediment, nutrients
10/14,22	McKenzie Creek 1995	Erosion control through structural practices, pasture improvement and establishment, critical area treatment, and woodland improvement through livestock exclusion.	Wayne	12200	Stream	Threatened aquatic life	Sediment, nutrients

APPENDIX J

Implementation Assistance

IMPLEMENTATION ASSISTANCE

The agencies and programs, which follow, are some of those that may be part of NPS program implementation in Missouri. The list is not intended to be either exclusive or all-inclusive. Included are existing requirements of other federal and state laws to the extent they are relevant. Addresses and telephone numbers are provided at the end of this section to obtain additional information on listed programs.

Department of Natural Resources
Water Protection & Soil Conservation Division

Soil and Water Conservation Program

The Soil and Water Conservation Program (SWCP) provides staff support for the Soil and Water Districts Commission. Program activities are supported by one half of the proceeds of a one-tenth of a percent Parks and Soils sales tax in Missouri. The other half is used to maintain the state's park system. In 1984 an amendment to the constitution of Missouri, Article IV, Section 47 (a)-(c) authorized the collection of the sales tax. The soils tax programs, which operate under the authority of RSMo 278, have been in place since 1986. More than 78 percent of the soils tax goes to landowners for soil conservation.

Grants to Districts: Each of the 114 soil and water conservation districts receives grants for their operation. Uses are determined by each locally elected board and include funding for management, clerical and technical personnel; information and education programs; equipment and general administrative expenses. The districts serve as the delivery system for the state's voluntary incentive programs and other soil and water conservation efforts.

Cost-share Program: Landowners are reimbursed for installing practices that prevent or control excessive erosion on agricultural land. The practices are designed to reduce soil erosion, maintain agricultural productivity and prevent degradation of water quality in rivers and streams. Landowners must invest 25 percent or more in their projects. Practices and reimbursement rates generally complement those of USDA with some exceptions.

Loan Interest-share Program: Landowners are reimbursed for a portion of the interest paid on private loans used to finance standard soil erosion control practices or the purchase of limited tillage conservation equipment. This program is being expanded to promote total resource management for agricultural land.

Research Grants: Grants are awarded to Missouri state colleges and universities for research projects to support the goals of the Soil and Water Districts Commission. Subjects vary from agronomic to sociological as they pertain to effective conservation practices.

Soil Survey: Staff provide assistance to accelerate the completion of the state's soil survey. Soil surveys are fundamental in natural resource documentation, planning and management as they identify specific soil types on the landscape. Field mapping for the initial inventory was completed in 2002.

Special Area Land Treatment (SALT) Program: Participants in specially designated watersheds use a combination of cost-share, loan interest-share and project grants to address soil and water conservation problems specific to that identified area and to carry out total resource management on their farms. The SALT program has already begun to expand to control pollution caused by sedimentation and chemical runoff from agricultural land.

Water Protection Program

The Water Protection Program (WPP) derives its authority from the Missouri Clean Water Law, Sections 644.006 through 644.141 RSMo, and provides staff support to the Clean Water Commission (CWC). Administrative rules promulgated under the Clean Water Law may be found in 10 CSR 20. Section 644.021 (1) RSMo designates the CWC and the water pollution control agency for the state, and 644.136 further designates the CWC as the water pollution agency for purposes of administering federal water pollution control acts.

The Clean Water Law, 644.051 RSMo specifically lists prohibited acts.

1. Causing pollution of any waters of the state. Placing, causing or permitting any water contaminant to be placed where it is reasonably certain to cause pollution of any waters of the state;

2. Discharging any water contaminants into any waters of the state that reduce the quality of such waters below water quality standards.

DNR has the authority to conduct investigations concerning violations of the Clean Water Law. Section 644.056 RSMo requires the department to cause investigations to be made upon request of the commission or upon receipt of information concerning alleged violations of the Clean Water Law, any standards, limitations, orders, rules or regulations promulgated pursuant to the law. Investigations may be conducted as deemed advisable by the department. DNR has the authority to attempt to eliminate violations through conference, conciliation or persuasion. Failing this or in order to immediately halt endangerment to the health or welfare of persons, DNR may order abatement or file an abatement complaint with the commission.

Section 644.076 RSMo allows the CWC or DNR to institute a civil action for injunctive relief to prevent violation and allows for the assessment of penalties. The attorney general or local prosecuting attorney may take action. This section also sets penalties for falsifying any documentation required by the Clean Water Law and for willful or negligent violation of the law.

In addition to the above penalties, Section 644.096 RSMo allows DNR to collect actual damage costs. These may include all costs and expenses necessary to establish and collect such costs, and the costs and expenses of restoring any waters of the State to their condition prior to the violation.

Animal waste permits and LOAs: DNR has regulatory authority over Animal Feeding Operations (AFOs), 10 CSR 20-6.300. Letters of Approval (LOAs) and construction or operating permits can be obtained for AFOs from the department based upon the total animal units proposed at a facility. Class II and smaller facilities are allowed to obtain a LOA on a voluntary basis (Class II = 300-999 animal units). Class IC (1,000-2,999 animal units), IB (3,000-6,999 animal units), and IA (>7,000 animal units) facilities are all required to obtain construction permits, 10 CSR 20-6.300. All construction permit applications require a fee of $500. Operating approvals and permits require a professional engineer's certification of structures by presenting a signature and seal on the application form. General operating permits are available for Class IC and IB facilities for $150 for up to five years. Site-specific operating permits for Class IA facilities are $3,500 per year.

Under 10 CSR 20.010-030 operators of Class IA Concentrated Animal Feeding Operations (CAFOs) are required to be certified by the department. The rule defines certification requirements, personnel who must be certified, level of certification required, and sets fees for certification and renewals.

State Revolving Fund: Section 644.122 RSMo allows the state to provide low interest loans to public entities for planning, design and construction of water and wastewater treatment facilities. The program is a cooperative effort of the US Environmental Protection Agency (EPA), WPCP, the Clean Water Commission and the Environmental Improvement and Energy Resources Authority. The loans provide financing at below market rates for 100 percent of the eligible cost of wastewater treatment and conveyance systems. At present, interest is approximately one third of the market rate of municipal bonds. Loans are made for up to 20 years.

Animal Waste Treatment System Loan Program: The Animal Waste Treatment Loan Program is a cooperative venture of the Missouri Departments of Agriculture and Natural Resources, WPCP, EPA, CWC and Missouri Agricultural and Small Business Development Authority (MASBDA), which administers the program. It is authorized in 644.122 RSMo, and funded through the Missouri State Revolving Fund from the sale of water pollution control bonds and federal capitalization grants. MASBDA's administrative authority is found in 348.220 RSMo.

The program is designed to finance animal waste treatment systems for independent livestock and poultry producers at interest rates below market levels. Loans may be used to finance waste management structures and equipment approved as part of a DNR LOA for an animal waste management system. Borrowers must not exceed the 1,000 animal unit limit. Loans can finance up to 100 percent of system cost, minus any federal or state cost-share assistance, and may be made for up to ten years.

Storm Water Permits: Under state regulations passed in August 1992, a Missouri State Operating Permit is required for storm water runoff from certain industrial sites, construction sites, and urban storm sewers (10 CSR 20-6.200). Most of these facilities are issued a general permit, which is written to cover a broad category of pollutant sources. General permits may use a combination of management practices, monitoring, and effluent limits to manage the pollutants.

Site-specific permits for storm water discharges are written when a general permit is not available for the activity; when the facility is a significant contributor of pollutants based upon such factors as proximity to sensitive waters, size of discharge, or nature of pollutants; or when the facility is not in compliance with its general permit. Site-specific permits will include a combination of management practices, monitoring requirements, and effluent limits based upon best available technology and water quality goals.

Secondary Containment: The department requires by rule, 10 CSR 20-8.500, that facilities which store, mix, apply, or repackage bulk agrichemicals (fertilizers and pesticides) for more than thirty consecutive days in a year, must have appropriately designed secondary containment facilities to prevent a release of chemicals into waters of the state. These secondary containment facilities must obtain a construction permit from the department before construction and subsequently an operating permit. Secondary containment facilities consist of protective walls or dikes around bulk storage tanks to contain spills, concrete pads under loading areas to facilitate the collection of spilled product and residue from cleaning of equipment, and provisions for proper management of rinsates generated during application equipment cleaning and use.

Nonpoint Source Pollution Management Program: This program is authorized and funded under Section 319 of the Clean Water Act. The NPS Management Program is an integrated approach that develops and coordinates nonpoint source activities with federal, state, local and private sector entities in information, education, demonstration, technical assistance, and implementation assistance.

Public Drinking Water Program

Authority for the Public Drinking Water Program (PDWP) is derived from the Missouri Safe Drinking Water Act, Section 640.100 through 640.140 RSMo with rules in 10 CSR 60. The program supervises the design, construction and maintenance of public water systems (PWS). Perhaps the most important function of the program, from a NPS perspective, is the requirement for monitoring for water contamination, publication of the monitoring results and establishment of maximum contaminant levels allowed in drinking water.

Drinking Water Monitoring Data: Section 640.120 RSMo requires monitoring for contaminants 1) as listed in state drinking water regulations, 2) included in the national primary drinking water regulations, 3) required under the federal Safe Drinking Water Act or 4) which DNR finds may be hazardous to public health. Specific contaminants and their maximum contaminant levels (MCLs) are found in 10 CSR 60-4.020 through

4.110. General classifications of contaminants are microbiological contaminants; inorganic chemicals; synthetic organic chemicals, which includes some pesticides; trihalomethanes; unregulated chemicals; and special volatile organic chemicals. Section 640.130 RSMo allows DNR to issue notification and abatement orders when it has been determined that an emergency condition exists which endangers or could be expected to endanger public health. Ambient water quality in drinking water supply reservoirs is not directly monitored. Drinking water is tested after treatment. However, the data is a useful tool and will show water quality standards violations in many instances.

In instances where PWSs are not in compliance with the MCL for particular contaminants, DNR, under 10 CSR 60-6.020 (1) of the Missouri Public Drinking Water Regulations, may after public hearing, grant an exemption from a MCL requirement. The department is required to provide to the PWS a schedule of compliance for each MCL requirement covered by the exemption. The compliance schedule contains conditions the department may prescribe and steps and timetable to move back into compliance. When the contaminant(s) is/are the result of agricultural activities, exemption conditions include a requirement to "work with Natural Resources Conservation Service, University Extension, Department of Agriculture, area farmers, and others in evaluating and implementing watershed protection measures and best management practices..." Watershed protection is a high priority for public water supplies and receives even more emphasis under the new Safe Drinking Water Act of 1996.

Source Water Protection Program: The Safe Drinking Water Act of 1996 (SDWA) requires states interested in flexible monitoring opportunities to delineate and assess drinking water source water areas throughout the state. States may also set up a Source Water Protection Program (SWPP). The steps involved in developing a SWPP include: 1) Inventory and characterize public drinking water sources; 2) Identify pollutant sources and relative impact; 3) Assess vulnerability of intake to contaminants; 4) Establish source water protection goals; 5) Implement the program; and 6) Monitor and evaluate program effectiveness. Through this program the PWS or any local government entity can petition the PDWP for approval to set up a local, voluntary partnership with any affected persons and organizations to protect the drinking water supply from contamination. EPA approval for Missouri's Source Water Protection Program is pending.

The NPS program and the SWPP can complement one another very effectively. For example, section 319 funding may be used for some assessment activities. In addition, the assessments developed for the NPS program can provide information and data about pollution sources which may contribute to contamination of public drinking water supplies and identify surface waters known or suspected of being contaminated by nonpoint source pollution. Conversely, the SWPP can provide information and data from source water assessments that could help expand coverage of state water quality assessments. Source water assessments may provide additional data upon which to base 303(d) listing decisions and also to develop TMDLs for a particular water body. Nonpoint source staff involved with TMDL studies are working closely with staff in the PDWP to share assessment data in an effort to reduce duplication.

The SDWA provides funding for a drinking water state revolving fund for low interest loans to public water systems for capital improvements (planning, design and construction of water plants, tanks, water lines, etc.). After the source water protection programs established by the SDWA are implemented, there may also be opportunities for loans from this fund to be used for source water protection activities.
Vulnerability Assessments: Federal regulations (40 CFR 141-143) require public water systems to perform baseline monitoring for all the chemical contaminants listed in the regulations. Some of the most common synthetic organic contaminants (SOCs) for which testing is required are pesticides; analyses are very expensive. If it can be determined that a selected chemical is not used, stored, disposed, manufactured or transported within one half mile of a public well or within a drinking water impoundment's watershed, then a monitoring waiver may be granted to that system for the specific chemical, thus reducing that monitoring requirement.

Missouri has issued waivers by performing vulnerability assessments on every public water supply system. A geographic information system (GIS) is used to record the location of all public wells and surface water intakes. Characteristics of the wells or watershed are recorded, as are sources of SOCs. A routine search of over 100 databases is executed every quarter to locate new sites where SOCs have been used, stored, transported, or disposed. The GIS can analyze which water supplies are vulnerable based on proximity of contaminant sources. Secondary considerations utilized to determine susceptibility include well construction, geology, overlying soil types, direction of groundwater flow, characteristics of contaminants and others. If a source of contamination is located within one-half mile of a well (450 wells out of 2000 total have been identified as vulnerable) or within the watershed of a surface water supply, that water source is considered vulnerable, and testing is required.

Air and Land Reclamation Division
The Land Reclamation Program (LRP) derives its authority from the Land Reclamation Commission, Sections 444.350 through 444.970 RSMo, and provides staff support to the Land Reclamation Commission. The U.S. Congress enacted Public Law 95-87, the Surface Mining Control and Reclamation Act of 1977, which regulates surface coal mining operations. It established a program and funding for reclaiming abandoned coal mine lands that were disturbed prior to August 3, 1977. The Land Reclamation Program obtained primacy to carry out the provisions of Public Law 95-87 from the Office of Surface Mining in 1981. The Land Reclamation Program also regulates industrial minerals and metallic minerals.

Surface Coal Mining: The Land Reclamation Program is responsible for regulating active coal mining activities within the state as outlined in Sections 444.800 through 444.970. Primary goals are to assure that surface coal mining is conducted in a manner to minimize or prevent adverse effects to the citizens of the state and the environment. The program is responsible for assuring that sedimentation and discharges from mining sites comply with NPDES requirements.

Industrial Minerals Mining: The Land Reclamation Program is responsible for regulating activities associated with the mining of clay, limestone, sand, gravel, barite and tar sands as outlined in Sections 444.500 through 444.789. Primary goals are to assure that the mining of these commodities is conducted in a manner to minimize or prevent adverse effects to the citizens of the state and the environment.

Metallic Minerals Mining: The Land Reclamation Program is responsible for regulating activities from the handling and disposal of waste associated with the mining, benefication, and primary smelting of minerals or mineral ores containing lead, iron, zinc, silver and gold as outlined in Sections 444.350 through 444.380 RSMo. The primary goal is to assure that metallic mineral wastes are disposed of properly to minimize or prevent adverse effects to the citizens of the state and the environment. All operations associated with the mining of metallic minerals are required to obtain an NPDES permit.

Abandoned Mine Lands: The Land Reclamation Program is responsible for reclaiming mined lands presenting health and safety problems associated with coal mining that occurred prior to August 3, 1977, as outlined in Sections 444.810 through 444.940. Priority for reclamation of past coal-mined lands is based on classification of 1) the protection of public health and safety from extreme danger (e.g., high walls and open shafts), and 2) the protection of public health and safety not constituting extreme danger, and 3) restoration of land and water previously degraded.

Reclamation is funded by a federal tax on coal. The U.S. Office of Surface Mining Reclamation and Enforcement collects from producing coal companies 35 cents a ton on surface mined coal and 15 cents a ton for coal mined underground. Money is deposited into the Abandoned Mine Land Reclamation Fund and dispersed through grants to states. Declining coal production has resulted in decreased allocations; therefore, Congress has included a minimum base funding amount for states with limited coal production to continue their reclamation programs. Language is included in the federal appropriation which allows AML funds made available to states to be used as non-federal match for programs related to the treatment or abatement of acid mine drainage.

Most abandoned mine lands in Missouri do not require reclamation and provide wildlife habitat and recreational opportunities. DNR offers technical assistance to owners of abandoned coal mine lands. Staff personnel can provide expertise in soils, revegetation and water quality. Such assistance includes literature, workshops and onsite visits with landowners to discuss their problems and improve revegetation and water quality on their property.

Environmental Assistance Office

DNR established the Environmental Assistance Office to provide services that can be described as information, education, training and assistance. The program serves owners and employees of businesses, agricultural operations, elected officials, local governments, teachers and the general public. Its primary function is to help people understand and comply with environmental statutes and regulations.

Pollution Prevention: This unit works to protect the environment by encouraging pollution prevention. Sometimes referred to as waste minimization or waste reduction, it is the use of materials, processes and practices that reduce or eliminate the creation of pollutants at the source. The unit provides pollution prevention information and assistance, training and presentations, informational materials and coordination with other DNR staff.

Environmental Education: The Environmental Education Unit's objective is to promote environmental literacy of Missourians by providing knowledge to effectively solve existing environmental problems, prevent new ones, and maintain a sustainable environment. Unit focus is upon in-service training for teachers, providing graduate-level college courses on environmental issues. Unit staff coordinate the production and collection of educational materials within the Division of Environmental Quality and distribute these materials.

Operator Certification and Training: This unit has two primary duties: certification of and providing training for water supply and wastewater operators. The unit has developed a statewide training plan for operators identifying what training is provided, and where it can be obtained, areas of training which are insufficient, and how those needs can be addressed. The unit publishes a bimonthly newsletter for certified operators, "Water and Wastewater Digest," to provide updates on training courses, changes in regulations, etc.

Business Assistance: The unit provides guidance to businesses to help them understand and comply with environmental regulations, obtain permits, access governmental information sources, and incorporate pollution prevention concepts into their operations. Unit staff provide technical assistance to businesses with emissions inventories as required in the Clean Air Act Amendments of 1990. It also maintains the Toxics Release Inventory database.

Local Government Assistance: Guidance is provided to communities with operator assistance and facilities troubleshooting, voluntary assessment of wastewater systems, individualized in-depth community assistance with cross-media environmental issues and project financing.

Agricultural Assistance: Staff assist farm operators and agribusiness in understanding and complying with environmental regulations and applying pollution prevention concepts, and conducts outreach efforts such as displays, presentations and workshops.

Information Service: EAO's information service staff provide Missouri citizens a direct link with DNR through a toll-free number. Individuals can promptly access professionals who can respond to environmental questions, complaints or concerns. EAO can provide many division publications and materials upon request.

GEOLOGICAL SURVEY AND RESOURCE ASSESSMENT DIVISION

Within DNR is the Geological Survey and Resource Assessment Division (GSRAD) which, through the Oil and Gas Council, has regulatory authority over potential use and development of Missouri's oil and gas resources (including exploration drill hole construction, abandonment and plugging), dams, and water resources. In accordance with 256.110 RSMo, the state geologist (division director) is authorized to cooperate with federal and state agencies and to enter into formal cooperative agreements. Section 256.050 RSMo gives GSRAD the responsibility for determining positions, formations, arrangements, composition and utilization of both surface and ground water. This section also requires the publication of appropriate reports of work completed and educational bulletins on geology, water and well construction.

Water Resources Program (WRP)

The State Water Plan, authorized under the Missouri Water Resources Law (640.400 through 640.435 RSMo) must prepare and periodically update a state water plan that assesses the state water resources. Technical publications on drought response planning, flood analyses, information directories and future public interaction help with informing the public and assisting future policy makers with the information they need to make the best decisions for the prudent use and protection of water resources. A seven volume technical water resource characterization study and six regional reports of functional water use problems and opportunities are being produced. Use of an interagency task force is mandated to provide direction for the plan. The task force is made up of the Missouri Departments of Agriculture, Conservation and Health; the University of Missouri College of Agriculture, Food, and Natural Resources; and other agencies and departments as appropriate.

Water Resources maintains records submitted by public water well drillers. The primary information about a well is contained in a driller's log, which is defined in Section 256.603(4). The log contains information such as depth, volume, and geologic strata encountered. When information from drillers' logs are linked together, a picture of geological conditions and ground water are obtained. This allows experts to predict where water supplies can be impacted by surface activities and assists in siting potential impact sources such as CAFOs in order to protect groundwater, springs and water supplies.

The Major Water Use Registration data files maintained in the program contain on a statewide basis the spatial location, intended use, quantity withdrawn, and source of water for those users who have the daily capacity to pump 100,000 gallons or more.

The WRP also provides technical assistance with stream erosion, deposition, surface water flooding, drought impacts, location and health of wetland resources, contributing areas for springs and wells, groundwater level monitoring and additional studies that are used to determine water movement and predictions of ground and surface water flow. Image processing and digital data analyses are used to determine contributing watersheds, streams, groundwater aquifers, wetlands and lakes for mapping. Data layers are analyzed

using ARC-INFO, ARC-View and PCI Satellite Imaging. These projects can show, and in the future will assist in, analyzing nonpoint source impacts upon the land, water and groundwater sources.

Under Section 640.418(1) RSMo special water quality protection areas may be established. Designation of these areas is related to exceedence of maximum contaminant levels (MCLs) in a public water system. DNR must consider the probable effects of the contamination on human health and the environment, duration of contamination, quality, quantity and use of the water, and effectiveness of protective measures.

Geological Survey Program
The Program has developed an Aquifer Classification System. The system regionalizes aquifers into areas according to their susceptibility to contamination. Areas were defined using hydrologic and geologic parameters of shallow bedrock or surficial deposits, aquifer recharge potential, presence or absence of an aquiclude, and the natural or current ground water quality. Losing stream demarcations determine where a surface to groundwater exchange is likely to occur. Designations are intended to protect groundwater.

One of the more important areas regulated by DGLS is that of water well drillers. Section 256.600 through 256.640 RSMo is titled the Water Well Driller's Act. Subsequent regulations are found in 10 CSR 23. Those who drill wells for water use, monitoring, or exploration holes wells are required to obtain a permit from DGLS. Regulations specify construction and plugging standards for well drillers and landowners. Considerations include drainage patterns, elevation, sanitation and pollution prevention. Also specified are distances from pollution or contamination sources such as chemical and fertilizer storage areas, manure storage areas and septic tanks. The Act also requires that water (dye) tracing must be registered and traces reported.

As a part of overall protection of ground water, 10 CSR 23-3.020 discusses maintenance and repair of wells and abandonment of wells. It delineates steps to be taken when a well is to be abandoned. Abandoned wells attached to a structure or on site must be plugged prior to connection with a public water supply in order to prevent cross contamination.

10 CSR 23-3.030 and 10 CSR 23-3.070 contain standards for well construction. These include specifications for well casings, minimum depths, grouting, etc. In addition, specific, regionalized standards are mapped in 10 CSR 23-3.090.

Missouri Department of Agriculture

Bureau of Pesticide Control
Pesticides: The Missouri Department of Agriculture (MDA) is the state lead agency for pesticide regulation and control. Generally, that responsibility may be divided into three areas: enforcement of laws relating to the use and misuse of pesticides; the certification and licensure of pesticide applicators and dealers; and the registration of pesticides in

Missouri. MDA has primacy for pesticide enforcement and the ability to certify pesticide applicators under authority of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

All pesticides sold in Missouri must be registered with MDA. Conditions for registration are found in the Missouri Pesticide Registration Act, 281.210-310 RSMo. MDA will pursue additional legal authority as deemed necessary to protect Missouri water resources from pesticide contamination.

Section 281.070 RSMo grants MDA the authority to investigate the use of pesticides. Investigations are conducted in response to complaints or when violations of the statutes or rules are identified during inspections. As defined in 281.020 RSMo, “use” is mixing, applying, storing or disposing of a pesticide. Misuse is “a use of any registered pesticide in a manner inconsistent with its labeling...”. When violations are identified, civil and/or criminal penalties (281.060 and 281.1-5 RSMo respectively) may be issued against responsible individuals.

MDA conducts inspections of pesticide manufacturers to assure that pesticides are properly registered, labeled and packaged. Formulation verification samples are collected and records are monitored in accordance with EPA criteria. Inspections of retail outlets are made to ensure that only pesticide products properly registered for use in Missouri are being offered for sale.

Section 281.025 RSMo gives MDA the authority to issue regulations. These regulations may prescribe application methods and the amounts and concentrations of pesticides used. Also, they may restrict or prohibit pesticide use in certain areas during specified periods of time when deemed necessary to prevent damage or injury. A pesticide’s use may be restricted if unreasonable adverse effects to the environment or public health result from its use. In determining the need for regulations, consideration will be given to pertinent research findings, and recommendations of other Missouri agencies, the federal government, and other reliable sources.

MDA certifies pesticide applicators and licenses pesticide dealers who sell restricted-use pesticides to the end user. Through University Extension MDA offers training to pesticide applicators and certifies all noncommercial applicators, private applicators and public operators who use restricted-use pesticides and all commercial applicators using pesticides. Licenses are required for pesticide technicians working in ornamental and turf, general structural and termite pest control categories. The purpose is to educate and set a level of competency so applicators and technicians are familiar with the human and environmental hazards associated with pesticide use.

The pesticide applicator certification program is managed by the MDA under statutory authority provided by the Missouri Pesticide Registration Act 281.210-282.310, RSMo (Cum. Spp. 1993), and the Missouri Pesticide Use Act 281.005-281.115 RSMo (1994). Its provisions attempt to ensure that pesticide use be both limited and controlled as follows: limit use to (1) appropriate concentrations, (2) approved uses, and (3) application

by trained persons. Generally, these specifications are itemized on the pesticide label. The Cooperative Extension Service provides training with participation from DNR.

Missouri Department of Conservation

The Missouri Department of Conservation (MDC) has designated authority to manage the fish, forestry, and wildlife resources of the state. The department's principal sources of revenue are receipts from the sale of hunting and fishing permits and the one-eighth of one percent conservation sales tax. Funds are also received through Federal legislation from user taxes on sales of hunting and fishing equipment apportioned based on state hunting and fishing license sales. Other funding is received under provisions of the Endangered Species Act and from one-time grants and contracts.

MDC makes available funding for three cost-share programs administered by the DNR's Soil and Water Conservation Program.

- The Wetland Heritage Program is funded jointly by MDC and the US Fish and Wildlife Service. Program objectives are providing fish and wildlife habitat, restoring native wetland vegetation, and developing and protecting riparian zones when wetlands are restored or created adjacent to rivers and streams.

- An additional 25 percent cost-share is available to landowners for seeding Conservation Reserve Program acres. The addition is designed to encourage more producers to enter land into the program and encourage planting those mixtures that have greater wildlife benefits.

- An additional 25 percent cost-share is available to landowners for wetland restoration on Wetland Reserve Program easement acres up to $50 per acre.

Agricultural Liaison: The agricultural liaison program is designed to counter declining wildlife habitat conditions on private land and involves working with state, federal and private entities which deal with agriculture. The program encourages awareness of the effect of farm practices on natural resources and development of farming systems beneficial to fish, forests and wildlife.

Fisheries Division

The Fisheries Division is responsible for the long-term survival of native aquatic plants, animals and habitats.

Stream Incentive Program: The Stream Incentive Program has three facets: The stream/watershed restoration project addresses stream-related watershed problems by encouraging willing landowners to protect and use their streams wisely. It provides cost-share incentives to help landowners keep livestock out of streams and ponds, control stream-bank erosion and improve fish and wildlife habitat.

Alternative Watering Sources for Planned Grazing Systems provides cost-share assistance to help landowners install alternative watering systems for livestock instead of using streams for watering. Eligible systems include mechanical and solar watering devices that provide water to livestock away from streams.

Stream Stewardship Agreements are for landowners that already have shown their dedication to long-term protection of healthy stream corridors. Landowners submit written bids for per-acre payments, and the MDC pays landowners cash over a ten-year period if they protect and manage stream-side property under a stream management plan and assure continued protection through a conservation easement. Stream Stewardship agreements are available only on priority streams. Fisheries district supervisors rank each stream based on resources in their areas. These may include smallmouth bass, endangered species, trout or recreational uses.

Streams for the Future: The Stream Incentive Program's roots extend back to the Streams for the Future initiative. Goals were to involve Missouri citizens in stream stewardship, improve fish and wildlife habitat along streams and help landowners use conservation-wise practices to protect stream resources.

Among programs developed to meet those goals was the Missouri Stream Team, an adopt-a-stream program sponsored by the Missouri Conservation Federation, MDC and DNR. Stream Teams pick up litter, plant trees, install fish habitat structures, bring information about stream conservation into classrooms, or take training to monitor stream water quality. The Volunteer Water Quality Monitoring Program is an extension of the Stream Team program offered to interested teams and team members. It provides various levels of training to allow citizens to monitor the physical, chemical, and biological aspects of streams.

MDC also provides technical advice and material assistance for stream-improvement projects. It maintains demonstration areas where landowners can see stream conservation in practice and can provide brochures that explain how to deal with common stream problems. Management biologists provide management advice and technical assistance to private landowners with lake or stream problems, stream erosion and habitat concerns, and provide technical assistance to state and federal agencies, local governments and public utilities.

Forestry Division

The Forestry Division is responsible for management and protection of the state's forest resources. Major objectives are rural fire protection, promotion of sustainable forests, research to improve forest management and biodiversity, sustainable management and protection of public lands, and cooperation with public and private agencies in disease and insect control.

Agroforestry Program: The Missouri Economic Diversification and Afforestation Act of 1990 (as amended, 1993) established the Agroforestry Program. It directed MDC to develop and implement the program in cooperation with several other organizations.

Agroforestry is the practice of planting or establishing rows of trees or shrubs bordered on each side by a narrow strip of ground cover, alternated with wider strips of row crops, grass or other crops. The intent is to provide state rental payments on Conservation Reserve Program (CRP) lands for an additional ten-year period after the federal contract expires, if those lands are used for agroforestry purposes. The program also allows participation on lands not enrolled in CRP. Due to budget constraints, no new sign-ups are being accepted for this program.

The program provides annual incentive payments that can be combined with other income from the land to produce income substantially equal to the previous CRP payment. Financial assistance to share the cost (up to 75 percent) is provided to establish trees and/or shrubs to be used in the program.

Agroforestry allows cropping systems using trees and row crops, forage crops, alternative crops and horticulture crops. Benefits include reduced erosion, buffer/filter strips, riparian protection, increased biodiversity, nutrient retrieval and opportunities for use of small acreages and niche markets.

Technical Assistance: Through a cooperative program with the US Forest Service, technical assistance is provided to private woodland owners. Service includes tree selection, planting advice, forest management recommendations, forest product utilization and market assistance, and wildlife management recommendations. Tree planting plans are prepared for qualifying communities to assist with plantings on public lands. Assistance is provided to forest product manufacturers and forest landowners on resource availability, market information, new technologies, manufacturing efficiency and training. Individual businesses are encouraged to improve utilization and reduce output of residues through environmentally acceptable manufacturing methods.

Forest Cropland: Under terms of the State Forestry Act, passed by the General Assembly in 1946, land classified as forest cropland is eligible for a partial tax deferment. A number of conditions apply, and the owner must agree to follow basic forest management requirements designed to keep the land in permanent forest production.

Wildlife Division

The Wildlife Division is responsible for programs related to wildlife resources of the state including management of 363 conservation areas. Field staff provide a range of technical assistance to private landowners and annually develop 400-500 management plans for new cooperators. The division operates two demonstration farms, trains Natural Resources Conservation Staff in wildlife management principles and has staff wildlife biologists assigned to all Missouri NRCS offices. Wildlife restorations are conducted with species such as ring-necked pheasants, prairie chickens, osprey and assisting other states in wild turkey restoration.

The division conducts research in all phases of wildlife management with an emphasis on long-term ecosystem studies. Approximately five cooperative studies on agricultural topics affecting wildlife are underway annually.

Outreach and Education Division

The Outreach and Education Division informs the public about Missouri's forest, fish and wildlife, and works to involve people in conservation activities and outdoor recreation. It uses a wide range of mass communications tools including a 400,000+ circulation monthly magazine, weekly news packet, TV and radio programs, Internet website, and a variety of audio, video, book and print publications.

Schools and young people receive special attention through grade-targeted curriculum materials, visual aids, lesson plans, and teacher workshops. These are coordinated through a team of field-based consultants who regularly visit schools and work closely with teachers and administrators.

Face-to-face service to the general public is provided through the division's four nature centers, metropolitan offices, ombudsman's office, exhibits and others. These units provide both programs and personal contact, answering questions and providing general background material on conservation.

Missouri Department of Health and Senior Services

The Missouri Department of Health and Senior Services (MDHSS) directs and manages public health functions and programs in the state, (192.005 RSMo). In accordance with Section 192.001 RSMo, the department is required to monitor adverse health effects of the environment and prepare population risk assessments regarding environmental hazards. These assessments may relate to water, toxics, and others.

Section for Environmental Public Health

The section provides consultation, technical assistance, and inspection services related to food protection, private water supplies, lodging establishments, risk assessments, and environmental investigations and follow-up of communicable disease outbreaks. Licensed private inspectors are now conducting evaluations of existing private water wells and on-site sewage treatment systems for individual homes when requested by lending institutions, realtors, property owners or potential buyers, as allowed in section 701.051 RSMo.

MDHSS maintains statutory authority over on-site disposal systems under Sections 701.025 through 701.059 RSMo and implemented by 10 CSR 20-3.060, Minimum Construction Standards for On-Site Sewage Disposal Systems; 19 CSR 20-3.070, Fees Charged by Department of Health for Inspection of Existing On-Site Sewage Disposal System Requested by a Lending Institution; and 19 CSR 20.3080, Description of Persons Qualified to Perform Percolation Tests or Soils Morphology Examinations in Determining Soil Properties for On-site Sewage Disposal Systems. Domestic, no-discharge sewage treatment facilities that have a designed maximum daily flow or an actual maximum daily flow of three thousand gallons or less fall under these sections. Single family residence with lots of three acres or more are exempted.

Section 701.038 RSMo limits complaint investigation to instances of communicable disease investigation and complaints by an aggrieved party or adjacent landowner. Section 701.040 requires MDHSS to develop a state standard for location, size of sewage tanks, length of lateral lines based on percolation rates or soil properties, construction, installation and operation of on-site sewage disposal systems. The statute goes on to set requirements for inspections, permits, system modification or major repairs and contractor registration, and directs fees be collected.

Persons installing or repairing an on-site sewage system should first contact the County Health Department. Information must be provided on an application indicating the soil and site conditions, systems design, and setback distances. All factors must be acceptable to minimum construction standards before a permit will be issued. Law provides penalties for installation of systems without required permits.

US Department of Agriculture

Natural Resources Conservation Service and Farm Service Agency

The Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA) in the U.S. Department of Agriculture have traditionally provided technical and financial assistance to landowners, producers and others needing to apply conservation practices. NRCS, formerly the Soil Conservation Service, has provided guidance for over sixty years in soil and water conservation. FSA, formerly the Agricultural Stabilization and Conservation Service, determined practices which would be cost-sharable, set cost share rates, and issued checks.

The conservation provisions of the 1996 farm bill simplified existing conservation programs and improved their flexibility and efficiency. The bill also created new programs to address high priority environmental protection goals. While the NRCS and the FSA retained the essence of their traditional roles of technical assistance and financial assistance respectively, the 1996 farm bill redefined and blended their responsibilities and authorities in targeting assistance and setting eligible cost shareable practices and rates.

The 1996 farm bill reformed an existing program, the Environmental Conservation Acreage Reserve Program (ECARP) which encompassed the existing Conservation Reserve Program, the new Environmental Quality Incentives Program (EQIP) and the Wetland Reserve Program (WRP). It phased in EQIP while ending the Agricultural Conservation Program, Colorado River Basin Salinity Control Program, Water Quality Incentives Program and the Great Plains Conservation Program.

Conservation Reserve Program: The Conservation Reserve Program (CRP) protects highly erodible and environmentally sensitive lands with grass, trees and other long-term cover. It allows up to 36.4 million acres to be enrolled nationally at any one time. New enrollments can replace expired or terminated contracts. It allows owners or operators who entered into a contract before 1995 to terminate contracts on certain acres after

giving written notice. Those contracts must have been in effect for at least five years. Lands with high environmental values are not eligible for early release.

Conservation Reserve Enhancement Program (CREP): The Conservation Reserve Enhancement Program is a new initiative established as part of the highly successful Conservation Reserve Program. CREP expands CRP's effectiveness by allowing USDA to work in partnership with States and local interests to meet specific conservation objectives. CREP is a community-based program, centered around local participation and leadership, with financial incentives and technical assistance provided by USDA. It is results-oriented, requiring clean program goals and annual monitoring to measure progress and ensure success. Like CRP, CREP contracts require a 10 to 15-year commitment to keeping lands out of agricultural production, ensuring lasting benefits.

Environmental Quality Incentives Program (EQIP): The Environmental Quality Incentives Program is a new program, which combines the functions of the Agricultural Conservation Program Water Quality Incentives Program, Great Plains Conservation Program and the Colorado River Basin Salinity Control Program. It was funded nationally at $130 million in fiscal year 1996, $200 million in 1997 and 1998 and $175 million in 1999. Livestock-related conservation practices will receive 50 percent of program funding on a national basis.

Conservation priority areas are established locally where significant water, soil and related natural resource problems exist, in cooperation with state and federal agencies and with the state technical committees. Higher priority for funding is given to areas where state or local governments offer financial or technical assistance, or where agricultural improvements will help meet water quality objectives. EQIP establishes five-to ten-year contracts to provide technical assistance and pay up to 75 percent of the costs of conservation practices focusing on manure management, pest management and cropland erosion control.

The bill defines land eligible for EQIP contracts as agricultural land that poses a serious problem to soil, water or related resources. It does not allow large livestock operations to be eligible for cost-share assistance for animal waste management facilities, but they do remain eligible for technical assistance. Activities must be carried out under the contract according to a conservation plan. Total cost-share and incentive payments are limited to $10,000 annually per person and to $50,000 for the life of the contract.

Wetland Reserve Program: The Wetland Reserve Program (WRP) incorporates changes designed to provide more flexibility to farmers and sets an enrollment cap of 975,000 acres nationally. The revisions require one-third of total program acres be enrolled in permanent easements, one-third in 30-year easements, and one-third in restoration only cost-share agreements. Individuals may choose the category for their eligible land. Landowners are provided up to 100 percent cost-sharing for permanent easements, 75 percent for 30-year easements and 75 percent for restoration cost-share agreements.

Conservation Research and Education: The National Natural Resources Conservation Foundation has been created as a charitable nonprofit corporation to fund research and educational activities relating to conservation on private lands. The foundation promotes innovative solutions to conservation problems through public-private partnerships. It also accepts private gifts of money or property to be used for conservation activities. Congress authorized $1 million annually from 1997 through 1999. The new foundation offers grants for research, education and demonstration projects. Grants will also assist conservation districts in building resources to carry out local conservation programs.

Conservation of Private Grazing Land: The grazing lands provision ensures technical, educational and related assistance is provided to landowners on the nation's 642 million acres of private grazing lands.

Flood Risk Reduction: Voluntary contracts are authorized that provide one lump sum payment to producers who farm land with high flood potential. The payment will equal 95 percent of the seven-year marked transition payments and other payments to offset estimated federal outlays on frequently flooded land. In return the producer agrees to comply with applicable wetlands and highly erodible land requirements and to forego commodity loans, crop insurance, conservation program payments and disaster payments.

Wildlife Habitat Incentives Program: This provision helps landowners improve wildlife habitat on private lands. It provides cost-sharing to landowners for developing habitat for upland wildlife, wetland wildlife, endangered species, fisheries and other wildlife. The state technical
committee is to be consulted for setting priorities for cost-share measures and habitat development projects.

Emergency Watershed Protection Program Floodplain Easements: The Secretary is authorized to purchase floodplain easements under the Emergency Watershed Protection Program.

Watershed Protection and Flood Prevention Act (PL-566)
PL-566 authorizes the U.S. Secretary of Agriculture to cooperate with state and local agencies in planning and carrying out improvements for soil conservation and other purposes. It provides for technical, financial, and credit assistance, by USDA, to local organizations representing the people living in small watersheds. It also provides for needed additional treatment and protection of federally owned lands within these watersheds.

The Watershed Protection and Flood Prevention Act works through local government sponsors and helps participants solve natural resource and related economic problems on a watershed basis. Projects include watershed protection, flood prevention, agricultural water management, erosion and sediment control, rural water supplies and water quality, fish and wildlife habitat enhancement, wetlands creation and restoration, and public recreation in watersheds of 250,000 or fewer acres.

Both technical and financial assistance are available through NRCS which provides allocations of funds for plan development and implementation of individual projects. A project application must be submitted by local sponsors and prioritized by the Missouri Soil and Water Conservation Districts Commission prior to NRCS planning assistance. Project sponsors can be local or state units of government and usually include soil and water conservation districts and local watershed subdistricts. Practices to improve water quality through watershed land treatment are eligible for financial assistance with PL-566 funds.

Resource Conservation and Development Program: Resource Conservation and Development (RC&D) is a program which helps people initiate, sponsor, plan and implement projects that will benefit their communities. NRCS administers the program and provides a coordinator to designated RC&D areas. Local councils define the goals and objective to meet local needs. Councils may seek technical assistance from federal, state and local governments, local soil and water conservation districts and private industry. They may also seek and accept donations, loans, grants, or cost-sharing arrangements to help fund projects that address land conservation, water management, community development or environmental enhancement.

Forestry Incentives Program: The Forestry Incentives Program was authorized by Congress in 1973 to share with private landowners the cost of tree planting, timber stand improvement and natural regeneration. Provisions were unchanged in the 1996 farm bill. The objective is to increase the nations supply of timber products with emphasis on continued sustained yield; cost-effective forest improvement practices; and enhancement of other forest resources. Federal annual cost share ranges up to 75 percent depending on county participation and cost share rates set for that county. Fencing is required, but not cost shared. A one-acre minimum wooded contract area is required.

Stewardship Incentive Program: The Stewardship Incentive Program is designed to encourage private landowners to actively manage their forest land and improve natural resources by providing cost-share assistance for the installation of environmentally oriented practices - plan development, reforestation and afforestation; forest improvement, agroforestry establishment; soil and water protection; riparian and wetland protection; fisheries habitat enhancement; wildlife habitat enhancement; forest recreation enhancement; and reforestation. A ten-acre minimum of wooded area is required except in agroforestry. The MDC has in recent years provided additional matching funds to keep the program intact.

Forest Service

The Forest Service is charged with promoting the sustainability of ecosystems and providing public service through conservation leadership. Providing benefits from the National Forest is a primary thrust of multiple use and sustained yield management. The signing of the Record of Decision for the final EIS in 1986 represents the first level of decision making related to land and resource management planning. This decision determined the desired future condition of the Mark Twain National forest and established the standard and guidelines under which future projects would be

implemented. This document was completed in accordance with the National Environmental Policy Act (NEPA) and the Council of Environmental Quality implementing regulations for NEPA. The Mark Twain Land and Management Resource Plan currently directs Forest management activities, including timber management, recreation, wilderness, fisheries, range, roads, minerals, fire, soils, water and air. Final level decisions focuses on the analysis and implementation of management practices and projects designed to achieve the goals and objectives of the Forest Plan, subject to FOIA and NEPA.

Specific language regarding Forest Service management is contained with the following 36 CFR Sections:

> 219.23 - forest planning shall provide compliance with requirements of the Clean Water Act and evaluation of existing or potential watershed conditions that will influence soil productivity, water yield, water pollution or hazardous conditions
>
> 219.27 – "conserve soil and water resources...", "provide for adequate fish and wildlife habitat to maintain viable populations...", and manage riparian areas to avoid detrimental water temperature and chemical composition changes, blockages of water course or deposits of sediment.

US Environmental Protection Agency

Agriculture Compliance Assistance Center: The US Environmental Protection Agency (EPA) with the support of the USDA has developed a national Agriculture Compliance Assistance Center (Ag Center) to provide a base for "one-stop shopping" for the agriculture community - one place for comprehensive information about approaches to compliance that are both environmentally protective and agriculturally sound. The Ag Center seeks to increase compliance by helping the agricultural community identify common sense ways to comply with environmental requirements.

The Ag Center will work with USDA and other federal and state agencies to provide information on topics such as pesticides; nonpoint source pollution; ground, surface and drinking water protection; animal waste management; agricultural worker protection and wetlands protection. It will also support regional and state regulatory agencies in their efforts to provide compliance assistance to local agriculture.

Office of Wetlands, Oceans and Watersheds

Nonpoint Source Control Programs: The Assessment and Watershed Protection Division serves as the national program manager for EPA's nonpoint source control efforts. It also assists and guides nonpoint source programs that each state is required to develop under Section 319 of the Clean Water Act. Under Section 319 EPA has awarded more than $420 million to States in 1990-1996. States use these grants to implement programs approved by EPA that include as appropriate, nonregulatory and regulatory programs for

enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects.

Total Maximum Daily Load Process: A challenging task faced by water program administrators in addressing water pollution is determining the specific pollution control measures necessary to meet and maintain water quality goals and standards. Section 303(d) of the Clean Water Act describes ways to approach this task through the establishment of Total Maximum Daily Loads (TMDLs). The TMDL is the greatest amount of pollutants that a waterbody can receive without violating water quality standards.

The Assessment and Watershed Protection Division assists states in implementing programs that target watersheds for TMDL calculations. After a watershed has been identified for priority attention, and the TMDL has been established, individual waste load allocations (or limits) are designated for point and nonpoint sources (taking into account natural background levels, as well as a margin of safety). After implementing any additional pollution control measures that may be necessary to meet the TMDL, monitoring is conducted to assess the effectiveness of these control actions.

Wetlands Protection Measures: EPA's wetland protection regulatory responsibilities include reviewing proposed dredged or fill materials disposal activities under Clean Water Act Section 404 and Section 10 of the Rivers and Harbors Act and, if appropriate, restricting or prohibiting the use of discharge sites for these activities. EPA also develops regulations, policies and guidance to provide environmental criteria for discharges of dredged or fill material into wetlands regulated under Section 404. A technical testing manual is being developed to evaluate proposed discharges of dredged material in waters of the United States, including wetlands.

Watershed Protection: EPA has turned to naturally defined hydrological ecosystems--watersheds-- as the primary focus for effort to protect and restore natural resources. A comprehensive approach is needed that takes into account threats to human and ecosystem health within specific watersheds. To some extent, this approach requires a departure from EPA's traditional focus on regulating specific pollutants and pollutant sources and an alignment of traditional regulatory and nonregulatory programs to support integrated natural resource management. Based on successes of comprehensive, aquatic ecosystem programs such as the Chesapeake Bay, EPA is promoting similar approaches across the nation in watersheds large and small, urban and rural.

Technical Assistance: The Office of Wetlands, Oceans and Watersheds (OWOW) recognizes the need for a strong base of scientific information as the foundation for making regulatory and nonregulatory decisions about resource protection and management and evaluating program success. The Office of Science and Technology (OST) is the primary technical support arm for all water programs and liaison with EPA's Office of Research and Development (ORD). OWOW works with OST and ORD to support research and develop technical guidance for programs. Technical support and information are provided to citizens, local governments, states and other federal agencies regarding water quality monitoring, assessment, and regulation.

Surface Water Quality Monitoring and Data Management: The Assessment and Watershed Protection Division prepares technical guidance for assessing water quality and program successes, develops water quality indicators, and coordinates surface water monitoring programs with related programs in EPA and elsewhere. Water quality data is available and useable nationwide through Storage and Retrieval (STORET) and other systems. A Geographic Information System (GIS) center to support water quality decision-making is being established. The Division also prepares the biennial National Water Quality Inventory, a report to Congress that aggregates and analyzes state reports of water quality data in a periodic snapshot of water conditions nationwide. Biological monitoring is being emphasized and supported through development and publication of protocols and methods. Guidance and a newsletter are also prepared to help volunteer monitoring programs nationwide.

US Department of Interior

U.S. Geological Survey, Water Resources Division

The mission of the U.S. Geological Survey (USGS) Water Resources Division (WRD) is to provide reliable, impartial, timely information that is needed to understand the Nation's water resources. WRD actively promotes the use of this information by decision-makers to:

1. Minimize the loss of life and property as a result of water-related natural hazards, such as floods, droughts and land movement.
2. Effectively manage ground water and surface water resources for domestic, agricultural, commercial, industrial, recreational and ecological uses.
3. Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

The USGS WRD has neither regulatory nor developmental authority; therefore, its sole product is information.

Consistent with the USGS mission, the WRD provides impartial, credible, and excellent science that is applied to issues relevant to water resources management, protection from hydrologic hazards, environmental protection and other public policies. WRD's primary strengths include:

1. Collecting, quality assuring, storing and disseminating basic hydrologic data on the quantity and quality of water.
2. Conducting assessments of availability of water, quality of water, water use, and water related hazards at scales that range from single data collection sites to regional and national scale.
3. Conducting interpretative studies and developing predictive models that describe the potential consequences of water related management actions.

4. Providing knowledge and expertise to assist various levels of government (Federal, State, local) in understanding and solving critical water resources problems.
5. Developing new methods for acquiring water resources information, including methods of data collection, quality assurance, data management, laboratory analysis, data analysis and simulation modeling.
6. Producing new understanding that describes or explains processes important to water related issues.

Federal Water Quality Programs

The USGS WRD actively proposes and annually funds water quality programs of a National scope. These programs are funded solely from the annual USGS congressional appropriation. Two programs, which are significant contributors to the National water quality database, are the National Water Quality Assessment and the National Stream Quality Accounting Network programs.

National Water Quality Assessment Program (NAWQA):

The NAWQA program was conceived in 1986 through Congressional appropriated funds that mandated the USGS to test and refine concepts for a long-term program to:

1. Provide a nationally consistent description of current water quality conditions for a large part of the Nation's water resources,
2. Define long-term trends in water quality, and
1. Identify, describe and explain, as possible, the major factors that affect observed water quality conditions and trends.

After a 4-year pilot phase of the NAWQA program, a committee of the National Academy of Science evaluated the design and potential utility of the program and recommended full-scale implementation for 20 study units in 1991.

The Ozark Plateaus region was one of the initial study units to be assimilated into the NAWQA program. The study unit is approximately 48,000 square miles in size and includes parts of northern Arkansas, southeastern Kansas, southern Missouri, and northeastern Oklahoma. Boundaries of the study unit approximate the natural flow boundaries of the Ozark Plateaus aquifer system. The study objective is to examine the major factors that affect the quality of surface waters and to assess trends of water quality in Ozark streams. Interpretation and presentation of data is published in a series of reports. The area is of particular NPS interest because of the growing number of confined animal feeding operations within Missouri.

National Stream Quality Accounting Network (NASQAN):

The NASQAN program began in 1973 to provide nationally comparable information on water quality. Consistent with the design of the national streamflow-gauging network, water quality measurements were made at stations at the downstream end of most

hydrologic accounting units; hence, the term *accounting* in the network name. At its greatest extent, the network was funded at $5 million annually and included more than 500 stations that were sampled monthly for suspended sediment, major ions (such as sulfate and chloride), trace elements (such as lead), nutrients (such as nitrate and phosphorus), sanitary indicators (such as fecal coliform), and limited biological information (such as chlorophyll-a). These data were intended to provide general-purpose information on the status and trends of water quality.
During 1993 and 1994, the NASQAN program underwent a major restructuring. This involved reducing the total number of stations and increasing the number of samples to be collected at each station. In addition, the parameter list was revised to include more of the chemicals, compounds and constituent elements that are relevant to current water quality management issues. Since 1995, the NASQAN program has focused on monitoring the water quality of four of the Nation's largest rivers--the Mississippi, the Columbia, the Colorado and the Rio Grande. NASQAN operates a network of 39 stations where the concentration of a broad range of chemicals, including pesticides and trace elements, and stream discharge are measured. From these data, source areas of contaminants can be identified; contaminants can be routed through the river system to determine gains and losses; and the amount of contaminants delivered to receiving waters--such as estuaries and reservoirs--can be estimated.

Three NASQAN stations are currently maintained in Missouri under the restructured program. These stations are the Missouri River at Hermann, the Mississippi River below Grafton, and the Mississippi River at Thebes. Samples are collected at these stations between 13 and 15 times a year. At least two samples are collected to represent events of extremely high flow including flood stage. About 100 dissolved constituents and 30 suspended constituents are measured in every sample. An extensive quality assurance/quality control program enables constituents present in very low concentrations (parts per billion) to be measured with definable accuracy and precision. Results are published annually by the Missouri District WRD office.

Water Resources Division Funding Sources
WRD achieves its mission by using funding from three distinctly different sources: (1) USGS Federal program funds, which provide 100 percent support for certain efforts; (2) Federal-State Cooperative program funds, which are a combination of Federally appropriated funds (up to 50 percent) and funds from cooperating agencies at the State and local level; and (3) reimbursable funds, which are contributed by various partners without any Federal match. Each source of funding brings its own benefits. The Federal program provides the foundation that allows WRD to address important national issues, and provides for the conduct of regional and national synthesis of data and information, which is unlikely to be funded by local, State and other Federal agencies. Federal programs also provide the primary source of funds for research and development, which is necessary for the long-term productivity of WRD and the hydrologic science community.

The Federal-State Cooperative program and the reimbursable program ensures the relevance of WRD work and helps WRD to identify emerging issues. The programs

provide a base of support for long-term data collection networks and interpretative projects that can be integrated to give regional and national understanding of the Nation's water resources. These programs and the Federal program also provide a network of field sites in diverse geographic and hydrologic environments where the USGS and others can test new scientific approaches, methods, and instruments under real world conditions.

Technical Assistance and Support Offered by the Missouri District

WRD activities in Missouri are conducted from three offices statewide by a staff of hydrologists, geologists, engineers, hydrologic technicians and support personnel. Consistent with the USGS WRD mission, the Missouri District is available to provide assistance in the collection and interpretation of water quality, ground water and surface water data. Below is a list of potential areas where the Missouri District can assist the NPS through either its Federal-State Cooperative or reimbursable funds program:

1. Data collection and interpretation to determine contaminants loads in runoff from agricultural areas to "waters of the state."
2. Calibrate hydrologic and water quality models for use in simulating water quality conditions of watersheds where minimal data are available.
3. Establish new baseline water quality monitoring networks or enhance existing networks to meet the demands of current water quality issues.
4. Refine the current understanding of the regional aquifers to better understand their susceptibility to the growing number of confined animal feeding operations (CAFO).
5. Provide storm water quality data collection and interpretation in urban areas.
6. Collect ground and surface water data to support the calibration of models to determine source area concerns for public and private drinking water resources.
7. Conduct research into the sources and types of microorganisms entering the hydrologic system as a result of the growing number of CAFOs.
8. Conduct biological monitoring as a tool in assessing stream health.
9. Using engineering models, show the affect of impoundment and other flow routing scenarios on the fate and transport of chemical and biological contaminants.
10. Conduct hydrologic and water quality assessments of implemented best management practices.
11. Refine the understanding of contaminant transport, on a large (watershed) scale, through the unsaturated zone within the various regions of the state.
12. Store all USGS collected water quality data in the National Water Information System data base.
13. Conduct geochemical investigations into environmental contamination resulting from mining and mine tailing storage.
14. Assess impacts of NPS contaminants on wetlands in Missouri.
15. Compute chemical mass balances in watersheds for determining contaminant assimilation capacities of receiving streams and lakes.

Fish and Wildlife Service

Partners for Fish and Wildlife: The US Fish and Wildlife Service (Service) began a national program in 1989 called Partners for Wildlife Program which was aimed at the restoration and enhancement of wetlands and associated uplands on private lands. Recently the program has expanded and the name changed to Partners for Fish and Wildlife. The program now includes the restoration and enhancement of riparian and in-stream habitats for fish, wildlife and federally-listed threatened and endangered species. In Missouri the program is being implemented cooperatively with the Missouri Department of Conservation (MDC). Its purpose is to restore and enhance wetlands, grasslands, streams and rare and declining habitats on private land through the establishment of fish and wildlife habitat development agreements or partnerships with private organizations, corporations and individual landowners.

The Service and MDC provide technical assistance to the landowner(s) with cost share being provided through the Service in exchange for a habitat development agreement stipulating that the restored or enhanced land will not be altered or modified during the term of the agreement. The cost share rate is 75 percent for ten years of program participation. Twenty-year or longer development agreements are possible at the landowner's discretion.

Challenge Cost Sharing: A companion program to the Partners for Fish and Wildlife Program, is the Challenge Cost Share Program which allows the Service to provide matching funds for projects that support the management, restoration and protection of natural resources on wildlife refuges, fish hatcheries, research facilities and private lands. The goal is to restore and enhance natural resources on federal and private lands in partnership with nonfederal public and private institutions, organizations and individuals. The Service provides up to 50 percent of the total project cost and cooperators provide the other 50 percent. Partners may contribute cash or in-kind services. A Challenge Cost Share Agreement defines the purpose and scope of the project, assigns partner responsibilities and certifies the contribution.

University of Missouri

The University of Missouri and University Extension provide the general public with research-based objective information. University Extension uses demonstrations and educational programming to show the practical application of this research to Missouri citizens.

Missouri is divided into eight Extension regions and serviced by regional specialists. University Extension's strong feature is the development and dissemination of educational programs and demonstrations. By combining the educational training and talents of regional Extension specialists, community programs cover a wider spectrum of problem solving techniques and skills. University Extension strives to develop working relationships in communities with citizens and other agencies. Educational programs,

demonstrations and in-service education seminars are available for agencies and the general public.

Water quality is a major focus area of University Extension on the state and regional level. Emphasis on educational programming, information and demonstration is used to promote water quality and continued learning throughout the state.

Missouri Watershed Information Network

The Missouri Watershed Information Network (MoWIN) is being established within the University Outreach and Extension Division to assist individuals, governmental and private agencies, schools and other groups in locating and accessing information about Missouri watersheds. MoWIN is a partnership of state and federal agencies, non-governmental organizations, natural resource interest groups, and private industry working together to facilitate access to watershed information in Missouri.

The goal of MoWIN is to help citizens increase their knowledge about current watershed conditions and best watershed management practices and strategies to improve Missouri's water quality.

MoWIN will provide information about: current watershed events and meetings, ongoing projects, local contacts, human resources, financial assistance, technical assistance, educational resources, and natural resource facts, reports and data. The information will be provided via the Internet, phone, fax, mail and personal visits.

Agriculture Private Sector

Agricultural organizations are a vital liaison between the government agencies and producers as leaders can help inform producers about new programs and regulations while giving input to agencies about such programs. The agricultural community has been extremely proactive in decreasing nonpoint source pollution by implementing a number of environmental programs, and by fostering a sense of cooperation between agencies and agribusiness.

Missouri Corn Growers Association

The Missouri Corn Growers Association is promoting NPS pollution prevention and cooperates in water quality initiatives that cut across agency and organization lines. It is embarking on BMP demonstration and watershed research projects to be implemented in various watersheds around the state. The projects will deal with pesticide runoff with the constituent of focus being atrazine. Potential management practices which will help reduce atrazine will be evaluated. Objectives are:

A. Measure the effectiveness of selected management practices in reducing the runoff of pesticides, nutrients and sediment from crop fields, with specific emphasis on atrazine, nitrogen and phosphorus reduction.

B. Monitor streams, tributaries and reservoirs in sub-watersheds to document trends and/or changes in pesticides, nutrient and sediment levels within these specific watersheds resulting from the implementation of selected nutrient and pesticide management practices.

Producers participating in whole field demonstrations targeting the effectiveness of selected management practices in reducing runoff will receive technical assistance, including nutrient, pest and forestry management and engineering support. Information will be collected on a field-by-field basis including all pesticide and nutrient applications, and the date, rate and type of product applied. Information will be gathered on tillage practices, timing, type of implement used, seeding dates, rates, varieties, all field inputs. This information will then be used to evaluate the economics of the cropping system through the use of the "MAX" program. (MAX, Farming for MAXimum Efficiency, is an economic management decision software developed by the Conservation Technology Information Center at Purdue University in Indiana.) All field locations and sampling stations will be tracked using a GPS mapping system.

Mo-Ag Industries Council

Mo-Ag Clean Pesticide Container Recycling Program

The Mo-Ag Clean Pesticide Container Recycling Program was established in 1991 to provide Missouri's agrichemical dealers and growers with an alternative to landfilling clean pesticide containers. Goals for this program are three-fold:

1. To provide an environmentally sound method of disposing of used, clean containers
2. To prevent NPS caused by stormwater washing pesticide residues into waters of the state, and
3. To inform dealers and growers on proper methods of cleaning pesticide containers as required by law.

Because of the growing concern over illegally burning pesticide containers and other environmental concerns, the Agricultural Container Research Council (ACRC) was formed in 1992 to promote the collection and recycling of empty crop protection chemical containers into innovative, environmentally sound end uses. The organization supports state-level container programs by designating contractors to granulate and transport flaked containers to recycling centers from state approved collection sites. The assigned sub-contractor for the state of Missouri is Tri-Rinse, St. Louis Missouri. ACRC provides this vital service for state-level programs; however, Mo-Ag Industries Council meets the balance of the administrative and other expenses. Volunteers perform the work. Mo-Ag provides educational and promotional materials and protective gear including gloves, aprons, earplugs and boots.

The Mo-Ag Clean Pesticide Container Program begins in late winter and usually ends with collection of containers in August and October. The program targets the collection of high density polyethylene (HDPE) containers two and one half gallons or less, but will take up to 55 gallon ag chemical containers. Mini bulk containers can be recycled by

contacting the sub-contractor. In 1997, Mo-Ag collected over 140,000 pounds of ag chemical containers. The chipped containers are now being used to make plastic industrial pallets that are used at ag-chem facilities or distributions, which can be used again and again. Other end uses of the collected plastic have included new pesticide containers and energy recovery.

Environmental Studies Internship
In 1998, Mo-Ag plans to offer an internship program for students through the Environmental Studies program at the University of Missouri. By participating in the collection and granulation process, a student will be able to earn one or two credits toward his/her degree.

Missouri Soybean Association
Representative Farm Economical and Environmental Model
The MSA, (Missouri Soybean Association) and FAPRI (Food and Agriculture Policy Research Institute) initiated this program to provide farmers information on ways to improve profitability and the environment by keeping soil, nutrients and crop chemicals in the field where they belong. This computer model is being developed by FAPRI will include three major soil regions of Missouri. Four to five farmers and an ag chemical dealer develop representative farms for their soil region. The individual farmers combine their financial and management practices to develop a “model” farm.

This project will provide producers from each region economical and environmental information about current management (baseline) and alternatives (future options). With this information a producer will be able to identify what environmental and/or financial impacts can be expected from a practice, e.g., planting a cover crop. The model may suggest altering chemical and fertilizer timing or a major change in crop management, all with the goal of improving farmers’ profitability while protecting the environment. People who are planning or in the process of making changes to meet the requirements will receive a three-year membership to the MSA after they complete their projects.

MSA Environmental Excellence Award. This program is designed to recognize a person in the state of Missouri who has made outstanding strides in adopting environmentally friendly, economically sustainable, practices. This person also receives a cash award for achievement in preventing movement of soil, nutrients and crop chemicals.

MFA Inc.
Pesticide Container Recycling
MFA serves as a collection point for properly rinsed pesticide containers that are then transported to sites for recycling.

Custom Applicator Rodeos
MFA sponsors applicator rodeos which not only are competitions for skills but which also test the participants for compliance with rules and regulation associated with pesticide application.

Grass Buffer Strip Program
As a member of the National Council of Farmer Cooperatives, MFA is sponsoring a nationwide program which encourages agricultural producers to sow grass buffer strips along waterways to filter and reduce sediment and crop protection chemical runoff from agricultural fields.

Missouri Poultry Federation
The Missouri Poultry Federation makes available a compilation of BMPs with guidelines for litter management and dead-bird composting produced by the US Poultry and Egg Association, NRCS, the Tennessee Valley Authority and EPA. The Federation, working with the Poultry Task Force (public, private and industry representatives) is supporting efforts to achieve 100 percent participation of poultry contract growers in obtaining a voluntary "Letter of Approval" from DNR. A cooperative Poultry Federation/NRCS program in Barry County provides technical assistance to growers in soil and litter nutrient testing for planning application rates.

Poultry companies plan to become more involved in growers' handling of litter. Flock servicemen visit sites weekly and will encourage BMP utilization and refer growers to appropriate sources for assistance. Independent contractors who haul litter will be addressed in hauler seminars.

Missouri Pork Producers Association
Environmental Assurance Program
The Environmental Assurance Program (EAP) began in Missouri in 1996 as an educational opportunity for pork producers. The original program included a basic understanding of environmental stewardship, a review of regulations, and an environmental audit to help producers plan for the future.

To continue addressing environmental issues, the National Pork Producers Council has developed five new modules that elaborate on specific areas of the original program. The modules are Composting, Odor Reduction, Manure Treatment and Storage Alternatives, Community Relations, and Pollution Prevention Strategies. The original EAP and the five new modules are currently available to producers through local workshops that are conducted by University Extension and Natural Resources Conservation Service personnel.

On-Farm Odor Assessment Program
The On-Farm Odor Assessment Program was developed to give individual pork producers advice on ways odor may be reduced and how they may improve environmental stewardship on their operations. The program will be conducted through site visits made by agricultural engineers and other resource people from University Extension, the Natural Resources Conservation Services, and private firms.

Following the on-farm visit, the participant will receive a written report regarding their operation. All information gleaned from the visit will remain confidential; it will be the

decision of the producer to implement the suggested changes. The program will be available to producers in March 1998.

Syngenta

Missouri Water Quality Program

Since 1995, Syngenta has offered a voluntary water monitoring program for triazine herbicide to any public water supply that wished to be involved. As of 1998, thirty-three public water supplies in Missouri participate in the program. Syngenta provides an immunoassay kit, mailing expenses and laboratory analysis. Both finished and raw water samples are taken by the public water supply twice a month except during late spring and summer where samples are taken weekly. Syngenta utilizes gas chromatography for split sampling of at least 10 percent of all samples.

Syngenta also partners with the Missouri Corn Growers Association and other federal and state agencies in the Watershed Research and Assessment Project. This five-year project will focus on agricultural field runoff reduction practices, education, outreach and the economics of such practices. Syngenta has also sponsored many federal, state, local and nonprofit water stewardship programs and meetings. In 1997, Novartis sponsored an Environmental Stewardship Award given through the Missouri Soybean Association.

IMPLEMENTATION ASSISTANCE CONTACTS

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Water Protection & Soil Conservation
205 Jefferson Street
P.O. Box 176
Jefferson City, MO 65102

Soil and Water Conservation Program	(573) 751-4932
Water Pollution Control Program	(573) 751-1300
Public Drinking Water Program	(573) 751-5331
Land Reclamation Program ALPD	(573) 751-4041
Environmental Assistance Office	(573) 526-6627
	(800) 361-4827

Geological Survey and Resource Assessment Division
Water Resources Program (573) 751-2867
205 Jefferson Street
P.O. Box 176
Jefferson City, MO 65102

Geological Land Survey Program (573) 368-2100
111 Fairgrounds Road
P. O. Box 250
Rolla, MO 65401

MISSOURI DEPARTMENT OF AGRICULTURE
1616 Missouri Boulevard (573) 751-4211
P.O. Box 630
Jefferson City, MO 65102

MISSOURI DEPARTMENT OF CONSERVATION
2901 W. Truman Blvd. (573) 751-4115
P.O. Box 180
Jefferson City, MO 65102

MISSOURI DEPARTMENT OF HEALTH AND SENIOR SERVICES
Information and assistance are available from health departments or nursing services located in most counties.

931 Wildwood (573) 751-6400
P.O. Box 570
Jefferson City, MO 65102

US DEPARTMENT OF AGRICULTURE

Information and technical assistance are available from USDA service centers located in most counties.

Natural Resources Conservation Service
or Forest Service (573) 876-0900
Parkade Center, Suite 250
601 Business Loop 70 West
Columbia, MO 65203

Farm Services Agency (573) 876-0932
Parkade Center, Suite 225
601 Business Loop 70 West
Columbia, MO 65203

US ENVIRONMENTAL PROTECTION AGENCY

USEPA Region 7 (913) 551-7000
901 N 5th Street
Kansas City, KS 66101

US DEPARTMENT OF INTERIOR

Geological Survey (573) 308-3500
1400 Independence Road
MS 200
Rolla, MO 65401

Fish and Wildlife Service (573) 875-1911
608 East Cherry, Room 200
Columbia, MO 65201

UNIVERSITY OF MISSOURI EXTENSION

Contact the office in your county for information or assistance.

AGRICULTURE -- PRIVATE SECTOR

Missouri Corn Growers Association (573) 893-4181
3118 Emerald Lane, Suite 110
Jefferson City, MO 65109-6860

Missouri Ag-Industries Council, Inc. (573) 636-6130
410 Madison
P.O. Box 1728
Jefferson City, MO 65102

Missouri Soybean Association P.O. Box 104778 Jefferson City, MO 65110-4778	(573) 635-3819
MFA Inc. 201 Ray Young Drive Columbia, MO 65201	(573) 876-5226
Missouri Poultry Federation 225 East Capitol Avenue Jefferson City, MO 65102	(573) 761-5610
Missouri Pork Producers Association 6235 Cunningham Drive, Route 11 Columbia, MO 65202-9612	(573) 445-8375

APPENDIX K

Proposed Water Quality Monitoring Program for Missouri

A PROPOSED
WATER QUALITY MONITORING PROGRAM
FOR MISSOURI

May, 1999

A comprehensive water monitoring plan includes components for monitoring both quality and quantity of surface and ground waters. A complete program includes:

1. FIXED STATION NETWORK where measurements are made, usually at fixed intervals at the same site over a period of many years. This network includes both chemical and biological monitoring sites.

2. SPECIAL STUDIES where a specific issue or question results in a relatively intense monitoring effort over a short period of time, usually to define cause and effect relationships. DNR uses these studies to support such actions as issuance of site specific, water quality based NPDES permits, documentation in support of enforcement actions for serious water pollution events and for development of water quality criteria.

3. SCREENING LEVEL DATA COLLECTION where large numbers of sites can be quickly evaluated for obvious water quality problems and can assist in directing more intensive monitoring.

<u>Fixed Station Water Quality Network: Surface Water Chemistry</u>

The present fixed station chemical water quality monitoring network in or near Missouri includes 108 sites of which 35 are cooperative sites jointly funded by DNR/WPCP and the USGS, two are cooperative sites jointly funded by DNR/DSP and USGS, six are funded by DNR/WPCP under contract with Crowder College and 65 are maintained by federal agencies, other states, cities and public water suppliers. In addition to this network, the University of Missouri, under contract to the Department of Natural Resources, has been monitoring water chemistry of approximately 110 lakes three times per year since 1988.

While a fixed station network of this size has served the water pollution control needs in the past, the relatively recent influx of large confined animal feeding operations (CAFOs), expansion of mining activities, continued controversy over gravel mining, and the need for more water quality information in and around critical watersheds in the state makes some additions to the present network advisable. DNR has recommended initiation of an additional 27 new monitoring sites and upgrading of six of the present sites. Included in this recommendation are three new stations in north Missouri to assess the impacts of existing large or other significant water contaminant sources, and upgrading of six existing sites in southwest Missouri to better assess the impacts of the significant poultry production in that area of the state. Several of the remaining new sites proposed would allow the department to develop information on existing water quality in areas which may some day be impacted by anthropogenic activities.

Existing and proposed expansions to the surface water chemistry network are shown in Element One below. Biological monitoring would be added to those sites appropriate for that type of monitoring.

<u>Fixed Station Water Quality Network: Bioaccumulation of Toxics</u>

From 1980 through 1993 DNR and EPA operated a cooperative Regional Ambient Fish Tissue Monitoring Program (RAFTMP) which analyzed whole fish (carp or redhorse sucker only) from about 20-24 fixed sites in Missouri annually. EPA changed the focus of the program in 1994 from one monitoring ecosystem health to one which more directly assessed human health impacts. The RAFTMP now has only 8 long-term sites monitored annually for whole fish to assess ecosystem health. Six additional fish fillet samples

to assess human health risk are taken annually. Individual sampling sites are monitored for one to three years.

Beginning in about 1983 when EPA reported fish in the Meramec River with elevated levels of chlordane and dioxin, the Department of Conservation began their own fish tissue monitoring network. This network did not use fixed sites, but changed most sites annually. It analyzed fish fillets from a variety of species. Thus most fish tissue data collected today is good for assessing human health risks but not so good for other fish eaters which may eat the entire fish (since fillets typically contain less contaminants by weight than the entire fish, analyzing the whole fish is a more sensitive indicator of bioaccumulatable toxicants).

New techniques for estimating bioaccumulatable substances using semi-permeable membrane devices (SPMDs) rather than fish tissue have been developed and are now in commercial use for organic compounds and are in development for heavy metals. If DNR finds this technology to be an acceptable and economically viable substitute for fish tissue sampling, it may replace fish tissue monitoring in part or in total. Specific monitoring locations are listed in Element Two below.

Fixed Station Water quality Network: Sediment Chemistry

One of EPA's major areas of emphasis in the last five years has been the development of sediment criteria. While this criteria development process has proceeded slowly, we anticipate that in the not too distant future, EPA will be urging states to adopt sediment criteria and begin monitoring sediments. DNR initiated a sediment sampling program in 1998. It includes both a fixed station component to document sediment quality on the major rivers and sediment monitoring in sites suspected of having sediment quality problems. Monitoring sites are listed in Element Three below.

Fixed Station Water Quality Network: Bacteria

Presently, bacteria data is collected monthly or 6 times annually at most fixed station chemical monitoring sites (see Element One). In addition, the Department of Natural Resources, DPHP conducts bacterial monitoring at approximately 20 swimming areas within Missouri State Parks and the Little Rock District, Corps of Engineers does some bacterial monitoring at swimming areas on reservoirs in their district, about 8-10 of these sites being in Missouri. Given the proper resources, DNR would like to upgrade the bacterial monitoring program in the following ways:

a. conduct a survey of federal, state and local governments on the locations the most heavily used by swimmers.

b. add bacterial monitoring to any heavily used areas not now monitored.

c. all new sites plus existing sites should be monitored at least every two weeks during the recreational season as defined in the WQ standards.

d. switch from the fecal coliform test to the E.coli test as the indicator of human health risk.

Element 1. Fixed Station Chemical Monitoring of Surface Waters

Note: If information is present in the "Agency" column, the site is presently being monitored by that entity. An "*" next to the "Location" column is a site not now monitored but proposed to be included in an expansion of the network. An "**" next to the "Location" column indicates a proposed upgrade of an existing station (increase in frequency and or parameter coverage).

Waterbody		**Location**	**Agency**	**Coverage**	**Freq.**	**Comments**
Mississippi R.		Keokuk	IEPA-GA	c,m	6	
		Alton		c,m		
		Grafton	DNR-GS	c,m		B,T
		Ilsah, ILL.	IEPA-GA	c,m	6	
		Canton		c,m		
	*	Hannibal		c,m		B,T
		E. St. Louis				
		Cape G-Thebes	NASQAN-GS	c,m	12	
	*	Caruthersville				
		Memphis	USGS	c,m		
Missouri R.		St. Joseph	DNR-GS	c,m	12	B,T
		ab. Kansas City	Water Co.	c,m,o	12+	
		Kansas City	KDHE	c,m	12	
		Sibley		c,m		
		Jefferson City		c,m		
		Hermann	NASQAN-GS	c,m		B,T

Waterbody		Location	Agency	Coverage	Freq.	Comments
		ab. St. Louis	Water Co.	c,m,o	12+	
		St. Louis	NBS/LTMP	C	24	
		St. Louis		c,m	12	
Des Moines R.		Keosauqua, Ia.	IDEQ	c,m	12	
		St. Fancisville		c,m	6	
Fox R.	*	Wayland		c,m	12	
Wyaconda R.						
N. Fabius R.						
M Fabius R.						
S. Fabius R.		Taylor	DNR-GS	c,m	12	B,T
North R.						
South R.						
Salt R.		New London		c,m	12	
Salt R.		Center	STLCOE	c,m	4	
N.Fk.Salt R.	*	nr. Hunnewell				B
M.Fk.Salt R.						
Elk Fk.Salt R.						
S.Fk.Salt R.		nr. Santa Fe				
Mark Twain Res.		Several	STLCOE	c,m	4	
Cuivre R.		Troy	DNR-GS	c,m	6	B,T
		nr. Mouth	NBS/LTMP	C,	24	
Dardenne Cr.		nr.mouth	NBS/LTMP	C,	24	
Peruque Cr.		nr.mouth	NBS/LTMP	C,	24	
Tarkio R.		Fairfax		c,m	4	
Nishnabotna R.						
Nodaway R.		Oregon		c,m	12	
		Graham	DNR-GS	c,m	12	B,T
		Burlington Jct		c,m	3	
Big Lake Marsh		Big Lake St. Pk.				
Platte R.		Platte City		c,m	12	
		Sheridan		c,m	3	
		Sharps Station		c,m	4	
102 R.		Hopkins		c,m	3	
Thompson R.		Chillicothe		c,m	12	

Waterbody		Location	Agency	Coverage	Freq.	Comments
		Cainsville		c,m	3	
Weldon R.		Princeton		c,m	3	
Medicine Cr.		Lucerne		c,m	3	
Mussel Fk.	*	Mystic (below PSF)		c,m		N
L.Medicine Cr.	*	Galt (below PSF)				N
Locust Cr.		Unionville		c,m	3	
Grand R.		Sumner	DNR-GS	c,m	12	B,T
M.Fk.Grand R.		Grant City		c,m	3	
M.Fk.Grand R.	*	Albany (below CG)				N
E.Fk.Grand R		Allendale		c,m	3	
Chariton R.		Prairie Hill	DNR-GS	c,m	12	B,T
		Livonia		c,m	3	
E.Fk.Chariton R.		Macon		c,m		
	*	Huntsville		c,m	12	T,N
M.Fk.Chariton R.		Salisbury		c,m	12	
Lamine R.		Blackwater		c,m	6	
	*	Pilot Grove		c,m	3	B
Blackwater R.	*	Nelson		c,m	3	B
Moreau R.		Jefferson City		c,m	3	
Osage R.		ab.Schell City	DNR-GS	c,m	6	B,T
		St.Thomas	DNR-GS	c,m	6	B,T
		nr.Warsaw		c,m	4	
		bl.Bagnell Dam		c,m	3	
Baker Br.		Taberville Prairie				
B.Buffalo Cr.		B.Buffalo Cr.WA.	DNR-GS	c,m	6	A,B
Coakley Hollow		Lk.Ozarks St.Pk.	DPHP-GS	c,m	6	A,B
Hahatonka Spring			DPHP-GS	c,m	6	A,B
Truman Res.		Several		c,m	4	
S.Grand R.		Urich		c,m	4	
Marais des Cygnes		Trading Post, Ks.	KDHE	c,m	12	B,T
		Worland		c,m	12	
L. Osage R.		Fulton, Ks.	KDHE	c,m	12	
Marmaton R.		Ft.Scott, Ks.	KDHE	c,m	12	
1st Nicholson Cr.nr.		Prairie SP	DNR-GS	c,m	6	A,B

Waterbody		Location	Agency	Coverage	Freq.	Comments
Sac R.		Dadeville		c,m	12	
Stockton Res		Several	Spfd-CU	c,m		
McDaniel Lake			Spfd-CU	c,m		
Fellows Lake			Spfd-CU	c,m		
Valley Water Mills Spg.			Spfd-CU	c,m		
Sac R.		Stockton		c,m	3	
Pomme de Terre R.		Polk	DNR-GS	c,m	6	B
PdT Res.		Several		c,m	3	
Pomme de Terre R.		Hermitage		c,m	3	
Bennett Spring			USGS	c,m	12	
Niangua R.		bl.Bennett Spg.	DNR-GS	c,m	6	A,B,T
		Windyville	NAWQA-GS	c,m	4	
Dousinbury Cr.		nr.Wall St.	NAWQA-GS	c,m	12	
Maries R.	*	Westphalia		c,m	3	B
Gasconade R.		Jerome	DNR-GS	c,m	6	B,T
	*	Hooker		c,m	12	B,T
		Rich Fountain		c,m	3	
Osage Fk.Gas.R.	*	nr.Drynob				A,B
Lick Fk.Gas.R.	*	nr.Falcon				A,B
Roubidoux Cr.		Waynesville		c,m	3	
Roubidoux Spring		Waynesville	DNR-GS	c,m	6	A,B
Big Piney R.		Devil's Elbow	DNR-GS	c,m	6	B,T
Paddy Cr.		Slabtown Spg.	NAWQA-GS	c,m	12	
Shanghai Spring		Devil's Elbow	DNR-GS	c,m	6	B,P,N
Meramec R.		Eureka		c,m	6	
		Sullivan	DNR-GS	c,m	12	A,B,T
Courtois Cr.		bl.Hwy.8	DNR-GS	c,m	6	A,B
Huzzah Cr.		bl.Hwy.8	DNR-GS	c,m	6	A,B
Meramec Spring		St. James	DNR-GS	c,m	6	S,B
Bourbeuse R.		Union	DNR-GS	c,m	12	S,B
Big R.		Richwoods	DNR-GS	c,m	6	B,N
Coonville Cr.		St.Fran.St.Park	DNR-GS	c,m	6	A,B
Pickle Cr.		Hawn St.Park	DNR-GS	c,m	6	A,B
Hdwtr Diversion	*	Allenville		c,m	12	B,T

Waterbody		Location	Agency	Coverage	Freq.	Comments
Whitewater R.						
Castor R.						
St. Francis R.		Several		C	6	
		Fisk	USGS	C		
		Silva	STLCOE	C	7	
		Saco		c,m	12	
		Patterson	STLCOE	c,m		
		below Wappapello	STLCOE	c,m		
Lake Wappapello		Several	STLCOE	c,m		
Big Cr.		Sam Baker St.Pk.	DNR-GS	c,m	6	A,B
Little R. ditches		Kennett		c,m	12	
		Horrnersville		c,m		
		Rives	DNR-GS	c,m	12	B,T
St.Johns Ditch						
upper James R.		Several	Spfd.CU	c,m	6	
James R.		ab.Wilson Cr.	City of Spd.	c,m	12+	
	*	Galena				B,R
Finley R.		Riverdale		c,m	12	
		nr.mouth	City of Spfd	c,m	12+	
Kings R.		Berryville,Ark.	ADPCE	c,m	12	B,R
Osage Cr.		ab.Berryville,Ark.	ADPCE	c,m	12	
		bl.Berryville,Ark.	ADPCE	c,m	12	
		Alabam	ADPCE	c,m	12	
Longs Cr.		Denver,Ark.	ADPCE	c,m	12	
White R.	*	bl.Beaver Res.		c,m		B,R
Table Rock Res.		nr.dam	USGS-A	c,m		
Roaring R. Spring			DNR-GS	c,m	6	A,B
Lake Taneycomo	*	Branson	USGS-A	c,m	6	B,T
N.Fk.White R.	*	Tecumseh		c,m	12	A,B,T
Bryant Cr.		Rippee W.A.	DNR-GS	c,m		A,B
Double Spring		Dora	DNR-GS	c,m	6	A,B
Norfork Res.		Tecumseh,Udall	USGS	C	6	
Black R.		Annapolis		c,m	12	
	*	Poplar Bluff		c,m	12	B,T

Waterbody		Location	Agency	Coverage	Freq.	Comments
		Corning,Ark.	ADPCE	c,m	12	
E.Fk.Black R.	*	Johnson Shut-ins				A,B
Current R.		Doniphan	DNR-GS	c,m	12	A,B,T
		Van Buren	GS/NPS	c,m	12	
		Pocohantas,Ark	ADPCE	c,m	12	
L.Black R.		Several		c,m	6	
Fourche R.		Middlebrook,Ark.		c,m		
Spring R.		Thayer	ADPCE	c,m	6	
		Hardy,Ark.	ADPCE	c,m	12	
Mammoth Spring		Mammoth Spg.,Ark	ADPCE	c,m	6	A,B
Eleven Pt. R.		Bardley	DNR-GS	c,m	6	A,B
		Pocohantas,Ark	ADPCE	c,m	12	
Greer Spring			USFS-GS	c,m		A,B
Montauk Spring			NPS-GS	c,m	2	
Welch Spring			NPS-GS	c,m	2	
Pulltite Spring			NPS-GS	c,m	2	
Round Spring			NPS-GS	c,m	2	
Alley Spring			NPS-GS	c,m	2	
Blue Spring			NPS-GS	c,m	2	
Big Spring			DNR-NPS-GS	c,m	6	A,B
Current R.		Montauk, Powder M.	NPS-GS	c,m	2	
Jack's Fk.		nr.mouth	DNR-NPS-GS	c,m	12	A,B,N
		at.Alley Spring		c,m	12	
Spring R.	*	Waco		c,m	12	T,N
		Crestline	KDHE	c,m		
Lost Cr.	*	Seneca		c,m	6	B,N
Blue R.		Stanley,Ks.	KDHE	c,m	12	
Indian Cr.		Overland Pk.,Ks.	KDHE	c,m	12	
		Leewood,Ks.	KDHE	c,m	12	
Perche Cr.		McBaine		c,m	3	
Cedar Cr.		Columbia		C		
		Ashland		c,m	12	
L.Sac R.		Walnut Grove	DNR-GS	c,m	6	P
Tebo Cr.		Leesville		c,m	12	

Waterbody		Location	Agency	Coverage	Freq.	Comments
M.Fk.Tebo Cr.		Leeton		c,m	12	
W.FkTebo Cr.		Lewis	USGS	c,m	12	
Dry Cr.		Devil's Elbow		c,m	3	
Meramec R.		Paulina Hills	DNR-GS	c,m	12	P,N,T
		Fenton	StL.Co.Water	c,m	12+	
Crooked Cr.		Dillard		M	12	
Big Cr.		Chloride		M	12	
Wilson's Cr.		Brookline	DNR-GS	c,m	6	P
		Battlefield	City of Spd.	c,m	12+	
James R.		Several	City of Spd.	c,m	12+	
James R.		Boaz	DNR-GS	c,m	6	P,T
Fall Cr.		Branson				
Roark Cr.		Branson				
Other Taney tribs.		Branson				
Main Ditch		Neelyville		c,m	12	
Center Cr.		Carterville		c,m	12	
	*	Smithfield		c,m	12	N,T
Turkey Cr.	*	Joplin		c,m	6	P,N,T
		Smithfield		c,m	12	
Short Cr.		Galena, Ks.		c,m	12	
Shoal Cr.	*	ab.Joplin		c,m	12	B,N
	**	ab.Capps Cr.	DNR-CC	c,m	12	B,N
		Galena, Ks.	KDHE	c,m	12	
L.Sugar Cr.		Caverna		c,m	12	
Elk R.	**	Tiff City	DNR-CC	C	12	B,N,T
Indian Cr.	**	Ginger Blue	DNR-CC	C	12	B,N
Big Sugar Cr.	**	bl.Mikes Cr.	DNR-CC	C	12	B,N
LSugar Cr.	**	Pineville	DNR-CC	C	12	B,N
Buffalo Cr.	**	Tiff City	DNR-CC	C	12	B,N
Capps Cr.	*	nr. Mouth		C,	12	B.N
Upper Huzzah & tribs				c,m	3	
Upper Courtois & tribs				c,m	3	
Indian Cr.				c,m	3	
Neals Cr.				c,m	3	

Waterbody		Location	Agency	Coverage	Freq.	Comments
Strother Cr.				c,m	3	
Brushy Cr.				c,m	3	
W.Fk.Black R.				c,m	3	
Bills Cr.				c,m	3	
Bee Fk.				c,m	3	
Logan Cr.				c,m	3	
Knob Cr.				c,m	3	

Element 2. Fish Tissue/Semi-Permeable Membrane Device Monitoring for Bioaccumulative, Trace Substances

Waterbody Location	Coverage	Freq.	Comments
* Mississippi River at Caruthersville	soc,m	1	B
* Mississippi River at Grafton, Ill.	soc,m	1	B,T
* Mississippi River At Hannibal, Mo.	soc,m	1	B
** Mississippi River at Thebes, Ill.	soc,m	1	B,T
** Missouri River at St. Joseph, Mo.	soc,m	1	B,T
* Missouri River at Hermann, Mo.	soc,m	1	B,T
** Platte River nr. Platte City, Mo.	soc,m	1	B
** Grand River at Brunswick, Mo.	soc,m	1	B,T
* S.Fabius River at Taylor, Mo.	soc,m	1	B,T
* Blue River nr. mouth (KC)	soc,m	1	P,N
** Osage River at St. Thomas	soc,m	1	B,T
** Gasconade River at Jerome	soc,m	1	B,T
* Meramec River at Sullivan	soc,m	1	A,B,T
* Meramec River at Paulina Hills	soc,m	1	P,N
* Big River nr. Richwoods	soc,m	1	N
* James River nr. Boaz	soc,m	1	P,N
** Little Sac River nr. Morrisville	soc,m	1	P
**Current River nr. Doniphan	soc,m	1	A,B,T
* Black River near Annapolis	soc,m	1	P
** Little River ditches nr. Rives	soc,m	1	B,T
* Center Creek nr Smithfield, Mo.	soc,m	1	N
* Lake Taneycomo near Powersite Dam	soc,m	1	B,T

Waterbody Location	Coverage	Freq.	Comments
* 4-6 additional sites that would be rotated annually among other streams or lakes in the state.			

Element 3. Ambient Sediment Chemistry Monitoring

Waterbody Location	Coverage	Freq.	Comments
* Mississippi R. at Cannon NWR	soc,m	1	B
* Mississippi R. at Riverlands EDA	soc,m	1	B
* Mississippi R. at St. Louis	soc,m	1	P,N
* Mississippi R. at Cape Girardeau	soc,m	1	B
* Mississippi R. at Caruthersville	soc,m	1	B
* Missouri R. nr. Bob Brown CA	soc,m	1	B
* Missouri R. at Kansas City	soc,m	1	P,N
* Missouri R. below Weldon Spring	soc,m	1	B
* Blue River at Kansas City	soc,m	1	P,N
*Grand River nr. Sumner,Mo.	soc,m	1	B
*Locust Cr. at Fountain Grove CA	soc,m	1	B
* Platte River at Platte City, Mo.	soc,m	1	B
* S.Fabius River at Taylor,Mo.	soc,m	1	B
* Creve Coeur Lake, St. Louis	soc,m	1	N
* Gasconade River at Jerome	soc,m	1	A,B
* Meramec River at Sullivan	soc,m	1	A,B
* Crooked Creek below Buick smelter	soc,m	1	P
* Meramec River at Paulina Hills	soc,m	1	P,N
* Big River nr. Richwoods	soc,m	1	N,
* L. Sac Arm, Stockton Reservoir	soc,m	1	P
* James River at Boaz	soc,m	1	P,N
* James R. Arm, Table Rock Reservoir	soc,m	1	P,N
* Current River at Doniphan	soc,m	1	A,B
* upper Clearwater Reservoir	soc,m	1	N
* upper Wappapello Reservoir	soc,m	1	N
* Big Creek below Asarco smelter	soc,m	1	P
* Little River ditches at Rives	soc,m	1	B
* Center Creek nr Smithfield,Mo.	soc,m	1	N

Waterbody Location	Coverage	Freq.	Comments
* Turkey Creek at Joplin	soc,m	1	P,N
* Elk River at Tiff City	soc,m	1	B
* 4-6 additional sites that would be rotated annually among other streams or lakes in the state			

KEY:

Coverage

c = Conventional chemical monitoring (water temperature, pH, specific conductance, dissolved oxygen, major ions, nitrogen, phosphorus, suspended solids, hardness, iron and bacteria).

m = Heavy metals.

soc = Synthetic organic chemicals (PAHs, PCBs, pesticides, volatiles).

Comments

A = High quality site, data collection to enforce Antidegradation Policy in Water Quality Standards.

B = Establish background water quality information

P = Assess impact of one or more point source discharges.

N = Assess impact of nonpoint sources(s).

R = Nutrient monitoring for Table Rock Lake.

T = Analyze for long term water quality trends.

Groundwater Monitoring

There would be two major components of the groundwater monitoring program. One, a network of wells of known depth and construction for water quality monitoring, and addressing such issues as suitability for drinking water and movement of saline-freshwater interface. Two, a network of wells measuring water levels and addressing issues such as rate of recharge, regional aquifer depletion (i.e., the Roubidoux in SW Missouri and NE Oklahoma), and profundity of cones of depression at sites like Springfield, Branson and Mexico. Both of these networks would cover all major potable aquifers in the state. Much water quality data is already available through ongoing monitoring by DNR/PDWP of public wells. A series of 50 wells would be added to the system, in cooperation between WPCP, PDWP, and DGLS. Semi-permeable membrane devices (SPMDs) would be used in a trial mode as part of this monitoring and if found appropriate, continued as a new tool for routine monitoring.

Surface Water Quantity Monitoring

This element of the monitoring strategy would upgrade the present flow monitoring network, to allow for additional monitoring at 20 sites. Presently, there are approximately 100 locations in the state where the USGS maintains instantaneous flow recording equipment. This proposal would allow flow monitoring to occur at locations that are critical for providing drinking water supplies as well as monitoring flow conditions and long term changes where significant water withdrawals occur or may occur, and in areas of interstate concern. The selection of these sites will be coordinated with PDWP and DGLS.

Biological Monitoring

In 1992 the Department of Natural Resources began a systematic sampling of the aquatic macroinvertebrate communities of 45 reference streams. These reference streams were picked because of the relatively good condition of the watershed they drained, the presence of a stable, permanently vegetated riparian zone and an absence of point source wastewater discharges. Sampling of these sites and selected sites with water quality or habitat impacts will lead to development of numeric biological water quality criteria within our water quality standards in three to five years.

When biological criteria are in place the department would add a few more reference streams and about 100 other stream locations across the state and begin a fixed station network of biological monitoring sites. These sites will be divided on an area proportional basis between the four ecoregions of the state prairie, prairie-ozark transition, ozark plateau, Mississippi Embayment. As a start, these new sites would be paired with new stations proposed for fixed station chemical monitoring.

The present reference sites are:

Prairie Ecoregion:

1. White Cloud Cr - Nodaway Co.
2. Honey Cr. - Nodaway Co.
3. E. Fk. Grand R. - Worth Co
4. Grindstone Cr. - DeKalb Co.
5. Long Br Platte - Nodaway Co.
6. W. Fk. Big Cr. - Harrison Co.
7. Marrowbone Cr. - Davies Co.
8. No Creek - Livingston Co.
9. W. Locust Cr. - Sullivan Co.
10. Spring Cr. - Adair Co.
11. E.Fk. Crooked R. - Ray Co.
12. Petit Saline Cr. - Cooper Co.
13. Burris Fk. - Moniteau Co.
14. L. Drywood Cr. - Vernon Co.
15. Middle Fabius R. - Lewis Co.
16. North R. - Marion Co.

Prairie-Ozark Transition:

17. Cedar Cr.-Cedar Co.
18. Pomme de Terre R.-Polk Co.
19. Deer Cr.-Benton Co.
20. L. Niangua R.-Hickory Co.
21. L. Maries R.-Maries Co.
22. Loutre R.-Montgomery Co.

Ozark Plateau:

23. Big Sugar Cr. - McDonald Co.
24. Bull Cr. - Taney Co.
25. Spring Cr. - Douglas Co.
26. North Fork R. - Douglas Co.
27. Jack's Fork - Shannon Co.
28. Sinking Cr. - Shannon Co.
29. Big Creek - Shannon Co.
30. L. Black R. - Ripley Co.
31. West Piney Cr. - Texas Co.
32. L. Piney Cr. - Phelps Co.
33. Meramec R. - Crawford Co.
34. Huzzah Cr. - Crawford Co.
35. Marble Cr. - Iron Co.
36. Boeuf Cr. - Franklin Co.
37. E.Fk. Black R. - Reynolds Co.
38. Sinking Cr. - Reynolds Co.
39. Rives aux Vases - Ste.Gen. Co.
40. Saline Cr. - Ste.Gen. Co
41. Apple Cr. - Cape G. Co.
42. L. Whitewater R. - Cape G. Co.

Mississippi Embayment:

43. Huffstetter Lateral Ditch - Stoddard Co.
44. Ash Slough Ditch - New Madrid Co.
45. Maple Slough Ditch - Mississippi Co.

Sites that have been sampled as part of the biocriteria development process that will probably be retained as fixed station biomonitoring sites include:

46. Clear Creek - Vernon Co.
47. McCarty Cr. - Vernon Co.
48. Horse Cr. - Cedar Co.
49. Brush Cr. - St. Clair Co.
50. N. Blackbird Cr. - Putnam Co.
51. E. Locust Cr. - Putnam Co.
52. W. Locust Cr. - Putnam Co.

The remainder of the sites must be evaluated in the field for suitability for this type of sampling and cannot be chosen at this time.

Beginning in 2001, DNR and MDC will begin a state-wide biomonitoring program for fish and aquatic macroinvertebrate communities. The program will monitor between 50 and 100 stream sites per year and will also measure the quality of the physical habitat of the stream site and collect some basic water chemistry data. About one-third of the sites will be randomly selected and the remainder will be selected based on potential or documented water quality concerns.

Special Studies

1. Wasteload Allocation Studies: DNR usually conducts 1 or 2 such studies each year. The results are used to develop a Qual 2e water quality model for a specific wastewater discharge and receiving stream and the model is then used to develop water quality based NPDES permit limits for the discharge. No expansion of this type of study is proposed.

2. Water Quality Studies of Specific Point and Nonpoint Sources: the Water Pollution Control Program usually conducts 3-4 abbreviated chemical studies per year to check on the status of streams below significant point or nonpoint sources to see if water quality standards are being met. This proposal would add an additional 2-3 studies per year to be performed by ESP personnel.

3. Large River Studies: None are presently being done. This proposal would request three such studies.

    a. Impacts of wastewater discharges on the lower 22 miles of the Meramec River.

    b. Delineation of mixing zones and water quality impacts of the Bissel Point and Lemay wastewater discharges on the Mississippi River.

    c. Impacts of the KC metro area discharges on the Missouri River.

4. Eutrophication of Ozark Lakes. The University of Missouri is presently under contract to DNR to make a detailed study of Table Rock Lake and its tributaries, to characterize the degree of eutrophication, identify limiting nutrient(s) and construct a nutrient budget for the lake. This study would lay the foundation for any rule changes the department might undertake to mitigate eutrophication in this reservoir. This proposal recommends that this same type of study be extended to all large reservoirs on a consecutive basis, with each study of 3-5 years duration. Reservoirs to be studied would include: Lake of the Ozarks, Bull Shoals, Norfolk, Clearwater, Wappapello, Stockton and Pomme de Terre reservoirs.

Screening Level Data Collection

The Department of Natural Resources uses a variety of data sources as initial indications of water quality that may require more sophisticated monitoring to quantify. This rudimentary form of monitoring data is referred to as “screening level data”.

The major sources are:

1. Inspections and complaint investigations by DNR, MDC or other agencies.

2. Rapid stream assessments made by DNR/WPCP.

3. Data submitted by trained volunteers:
   a. DNR/UMC lake volunteer monitoring program.
   b. DNR/MDC stream water quality monitoring program.

4. Miscellaneous reports.
   No expansion in this type of data collection is proposed.

BUDGET

FIXED STATION NETWORK

Surface Water Chemistry	
27 new sites 6 or 12 collections/yr. @ $10,000/site	270,000
upgrade 6 SW Missouri sites @ $9,000/site	54,000
(contracted to USGS or private contractor)	
Surface Water Flow Monitoring	
20 new sites @ $6,000 initial installation/site	120,000
20 sites @ $2,000 annual cost/site	40,000
(contracted to USGS)	
Bioaccumulation of Toxics	
fish collection 15 additional sites/yr. @ $400/site	6,000
analysis 15 addn. composites for dieldrin series, PCBs, lead, mercury, cadmium @ $600/sample and evaluation of SPMD for inclusion in ambient monitoring plans	9,000
(0.35 FTE expansion ESP/FS section)	

Sediment Chemistry	
35 sites, 1 collection/yr. @ $300/site	10,500
analysis of 35 samples for heavy metals, dieldrin series, PCBs, PAHs, commonly used pesticides, and microtox screen for sediment toxicity @ $1050/sample	36,750
(0.35 FTE expansion ESP/FS section)	
Bacteria	
sample collection at estimated 15 new sites, sampled 20 times/yr.	12,500
collection of 10 addn. samples/yr. at each of 30 existing sites	12,500
analysis of 600 samples @ $30/sample	18,000
(0.40 FTE expansion ESP/FS or regional office)	
Groundwater Quality	
collection of water samples from 50 wells four times/yr.	20,000
(0.10 FTE expansion ESP/FS or regional offices)	
analysis of 200 groundwater samples for major ions, heavy metals, bacteria, nitrate-N, common herbicides @ $350/sample	140,000
(0.20 FTE expansion ESP/FS or regional offices)	
Groundwater Levels/Aquifer studies	
measurement of 50 wells four times per year	20,000
(0.10 FTE expansion DGLS)	
Biological Monitoring (Aq. Invertebrates)	
2.0 FTE expansion in ESP/FS section	110,000
additional water quality support monitoring	10,000

SPECIAL STUDIES

Water Quality Studies of Discrete Point/NPS Areas	
0.25 FTE expansion in ESP/FS section, E&E, analytical costs	30,000
One large river study per year	
0.30 FTE expansion in ESP/FS section, E&E, analytical costs	50,000

Eutrophication of Lakes Annual grant to Univ. of Missouri	50,000
Total maximum daily load (TMDL) analyses in addition to special studies noted above 0.5 FTE expansion in WPCP, E&E, analytical costs	70,000
Ambient toxicity of streams using sensitive indicator organisms to establish conditions and trends before widespread toxicity becomes apparent	10,000

APPENDIX L

Section 319 Funding and the Clean Lakes Program

SECTION 319 FUNDING AND THE CLEAN LAKES PROGRAM

Introduction

In 1972, the Clean Lakes Program, a federal grant program, was established as section 314 of the Clean Water Act. The purpose of this program was to provide financial and technical assistance to States for restoration and protection of publicly owned lakes. Program activities were directed at diagnosing the condition of lakes and their watersheds, determining the extent and sources of pollution, developing feasible lake restoration and protection plans (Phase I Diagnostic/Feasibility Studies), implementing plans (Phase II Restoration/Protection Implementation Projects), and evaluating the longevity and effectiveness of various restoration and protection techniques (Phase III Post Implementation Monitoring studies). In addition, Clean Lakes Program funding could be used for statewide assessments of lake conditions (Lake Water Quality Assessment grants) and for the development of institutional and administrative capabilities to carry-out lakes programs.

Between 1976 and 1994 the Clean Lakes Program provided approximately $145 million of national funding to address lake problems, but there have been no appropriations for the program since 1994. July, 1998 USEPA guidance states that Section 319, Nonpoint Source Program funding can be used to fund Clean Lakes projects. In order to be eligible for funding, lake and reservoir management needs must be clearly identified in each state's Nonpoint Source Management Plan as well as eligible management practices.

Lake and Reservoir Pollution Control

Water Quality Standards promulgated to protect Missouri's waters for designated uses form the basis for pollution control efforts for lakes and reservoirs. All lakes in Missouri that are considered to be "waters of the state," those not entirely confined and located completely on lands owned, leased or otherwise controlled by a single person or by two or more persons jointly or as tenants in common, are protected by the general criteria and antidegradation provisions of the Water Quality Standards. The general criteria prohibit conditions that include aesthetic problems due to suspended or deposited material, discoloration, odor or conditions harmful to aquatic life. The antidegradation requirements prohibit lowering of water quality unless such action is an economic or social necessity to the state. In addition, 415 classified lakes are covered by numeric criteria. Classified lakes include any lake that falls into one of the following three categories: (1) small public drinking water reservoirs; (2) large multi-purpose reservoirs; and (3) reservoirs or lakes with important recreational values. In Missouri, the primary sources of lake and reservoir impairments are sediment, pesticides, and nutrients (see 303(d) list, Appendix F).

Restoration and Management Techniques

Effective and appropriate Best Management Practices should be implemented to the extent possible in the watersheds of lakes and reservoirs impaired by nonpoint source pollution. Sources of pollution must be managed sufficiently, in some cases on a periodic or continuing basis, to assure that the pollution being remediated will not recur. Some lakes may require the implementation of in-lake management techniques in order to correct the impacts of past pollution. In-lake management techniques which had been funded under Section 314 can now be funded under Section 319 in the context of an appropriate Clean Lakes project (e.g. Phase II

Restoration/Protection Implementation Projects). The following in-lake management techniques are eligible for Section 319 funding:

- Phosphorus Inactivation
- Dredging
- Dilution and Flushing
- Artificial Circulation
- Hypolimnetic Aeration
- Hypolimnetic Withdrawal
- Sediment Oxidation
- Biomanipulation
- Algicides
- Water Level Drawdown
- Shading and Sediment Covers
- Biological Controls (Fish, Insects)
- Harvesting/Planting
- Herbicides
- Limestone Addition to Lake Surface
- Injection of Base Materials into Lake Sediment
- Mechanical Stream Doser
- Limestone Addition to Watershed
- Pumping of Alkaline Groundwater

Other projects that Section 314 funded that may now be funded through Section 319 include statewide lake assessments and lake volunteer monitoring programs.

REFERENCES

U.S. Environmental Protection Agency, 1990, The Lake and Reservoir Restoration Guidance Manual. EPA-440/4-90-006. Office of Water (WH-553), Washington, DC.

Wayland, III, Robert H. Memo to EPA Regional Water Division Directors and State and Interstate Water Quality Program Directors. 9 July 1998.